CenSARA 101 – Clearing the Air

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ONLINE VERSION

AUGUST 2022

Course Agenda

- Historical overview
- National Ambient Air Quality Standards (NAAQS)
- Air monitoring
- New Source Performance Standards (NSPS)
- National Emission Standards for Hazardous Air Pollutants (NESHAPs)
- Regional Haze
- Modeling
- Title V Program
- Acid deposition control
- Interstate and International Issues
- Pollutant formation
- Emissions Inventory
- Pollution control technology

Important Stuff

Stuff You Should Know

- Emergency Exits
- Parking
- Restrooms
- Vending Machines
- Where to eat – Lunch is on your own

Start at 8:30am

Stop no later than Noon

- Some “Homework” or assignments

OK to ask questions anytime, but otherwise stay muted

Please raise your hands in the app so that we can address your questions.

Course Objectives

- General understanding of:
  - The various air quality regulatory programs
  - The technical tools used to implement them
  - How the programs and the tools fit together
  - How your job fits within the air quality program
  - How your job supports the goals of the air quality program
  - The federal/state/local partnership
- Introduction to many of the terms and acronyms associated with the air quality program
- Acronyms in the appendix

So, 4 days in this virtual classroom?

- Hopefully entertaining lectures punctuated by insightful questions from the class
- Intermingling of boring legal stuff with interesting technical content
- Participation by class members who clearly know more than me about a subject
- Class exercises or questions to see who has successfully remained awake
- Intermittent images of Class I areas to see who knows their geography
- A short exam at the end
- Feedback from you

Introductions

Name

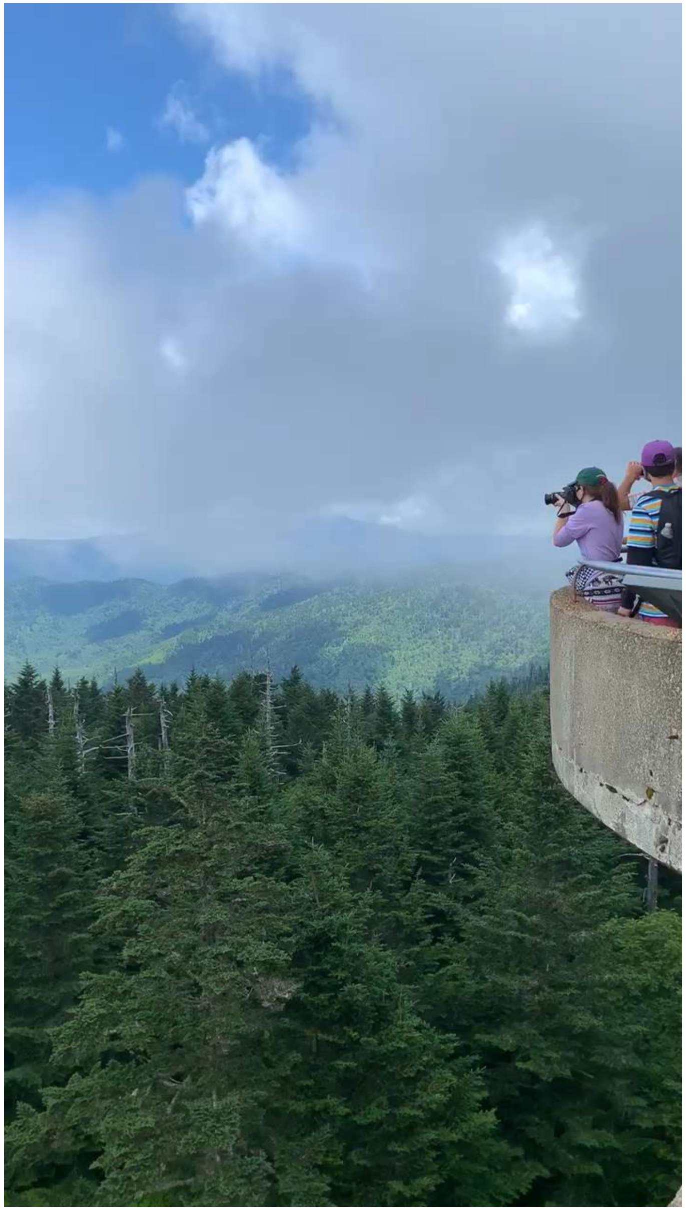
Educational Background

Where do you work in the Agency?

What are your major job duties?

How long in this job?

Something about yourself that's not job related



Great Smokey Mountains National Park

Clingman’s Dome 6,644 Feet Elevation

July 24, 2020

Haleakala
National Park

Island of Maui

10,023 Feet
Elevation

July 21, 2019

Introduction and History

Historical Highlights

When	What
Long, long ago	Volcanoes, meteorites, natural fires
Not quite so long ago	Man discovered fire.......smoke, jerky
Greek and Roman empires	Lead and silver smelters
1307	King Edward I banned burning of sea coal
Late 1700’s	Industrial revolution
Mid 1800’s	Steam powered transportation
1880’s	Smoke control ordinances
1897	Ringelmann Chart
Early 1900’s	Cars, trains, and airplanes

Historical Highlights

When	What
Early 1900's	Cities first banned emissions of dense smoke as a public nuisance
1930	Meuse Valley, Belgium – 60 deaths, thousands sick
1948	Donora, PA - 20 death, thousand sick
1950's	First state air quality programs
1952	First London killer fog -- 4000 deaths
1955	First Federal Air Pollution Control Act
1963	First federal funds for state and local programs
1970	Federal CAA: NAAQS, NSPS, NESHAPS, SIPs, Mobile sources, EPA formed

Temperature inversion, also called thermal inversion, a reversal of the normal behavior of temperature in the troposphere (the region of the atmosphere nearest Earth's surface), in which a layer of cool air at the surface is overlain by a layer of warmer air. (Under normal conditions air temperature usually decreases with height.)

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Bhopal Disaster 1984

Tank 610 in 2010. During decontamination of the plant, tank 610 was removed from its foundation and left aside.

Union Carbide India Limited

Historical Highlights

When	What
1977	CAA amended - primarily relating to PSD and NA-NSR
1984	Bhopal, India: Air toxics release - 7,000 to 20,000 deaths
1987	Montreal protocol – stratospheric ozone
1990	CAA amended: NA areas, Fuels & vehicles, HAPs, Acid rain, Operating Permits
1999	Regional Haze rule: public welfare, RPOs
2009	GHG Endangerment Finding

Civics Review

- Laws
  - Passed by Congress or State Legislatures
  - Laws create our agencies - MDNR and EPA
  - Laws define the authority of the agencies
    - Hire folks, charge fees, promulgate rules, write permits, inspect, enforce, monitor, collect information, etc.
  - Authorizing legislation
    - authorizes a legal entity to perform certain actions
    Clean Air Act (CAA)
    - Federal law authorizing EPA to protect air quality
  - Local Air Quality Act
    - State law authorizing your agency to protect air quality
    - Arkansas Code Annotated Title 8 Environmental Law

Civics Review

- Regulations
  - Passed by a regulatory entity authorized by law
    - State Agency and EPA
  - Code of Federal Regulations (C.F.R.)
    - Regulations promulgated by a federal regulatory body as authorized by federal law
      - 40 CFR xxx
  - Local Administrative Regulations
    - Regulations promulgated by a State regulatory body as authorized by State law
  - Regulations have the force and effect of law

Civics Summary

- Environmental laws generally authorize a regulatory body and define its scope and authority
  - (i.e., in general, the focus of environmental laws is on the regulatory agency)
- Environmental regulations generally define the requirements which a regulated entity must meet
  - (i.e., in general, the focus of environmental regulations is on the regulated entity)
- EPA routinely uses draft guidance documents to achieve what a state might do in regulations

Federal Legislation – 1970 CAA

- Required establishment of National Ambient Air Quality Standards (NAAQS)
- Required development of New Source Performance Standards (NSPS)
- Required development of National Emission Standards for Hazardous Air Pollutants (NESHAPS)
- Authorized State Implementation Plans (SIPs)
- Placed primary responsibility for mobile sources and fuels with feds

Federal Legislation – 1977 Clean Air Act Amendments

- Attainment deadlines of the 1970 CAA weren't being met
- A more stringent major source permit review was authorized
- Resulted in more stringent PSD and NA-NSR programs

Federal Legislation – 1990 Amendments

- Amended nonattainment provisions
  - Classification of areas based on concentrations (design values)
- Mobile sources
  - Authorized states to adopt California car regs
  - Reformulated gasoline (RFG)
- Modified the NESHAPS program
  - Listed HAPs
  - Changed from health-based to technology based
- Acid deposition program (Acid Rain)
  - SOx controlled through market based, cap and trade program
  - NOx reductions through command and control
- Operating Permits
  - Tied everything together
- Stratospheric Ozone protection

Clean Air Act Overview

Title I: Air Pollution Prevention and Control

- Part A: Air Quality and Emission Limitations

CAA Section	Standards	Pollutants	40 C.F.R. Part
107	Designations	Criteria	81
109	NAAQS	Criteria	50
110	SIPs	Criteria	51
111	NSPS	Criteria	60
112	NESHAPs	HAPs	61
112	MACTs	HAPs	63

- Part C: Prevention of Significant Deterioration
  - Subpart 1 – Clean Air (40 C.F.R. §51.166)
  - Subpart 2 – Regional Haze (40 C.F.R. § 51.308)
- Part D: Plan Requirements for Nonattainment Areas (40 C.F.R. §51.165)

Title II: Motor Vehicles Title

III: General Provisions

Title IV – Acid Deposition Control (40 C.F.R. Part 71)

Title V – Permits (40 C.F.R. Part 70)

Title VI – Stratospheric Ozone Protection (40 C.F.R. Part 82)

Federal Programmatic Responsibilities

- Setting the NAAQS
  - Developing Criteria Documents
  - Approving state designations and State Implementation
- Developing NSPS
- Developing NESHAPS
- Mobile sources and fuels programs
- Acid Rain program
- Stratospheric Ozone protection
- Regional Haze program requirements and approving States’ Regional Haze Programs
- Title V program requirements and approving States’ Title V programs
- Oversight of state/local programs
- Providing grant dollars

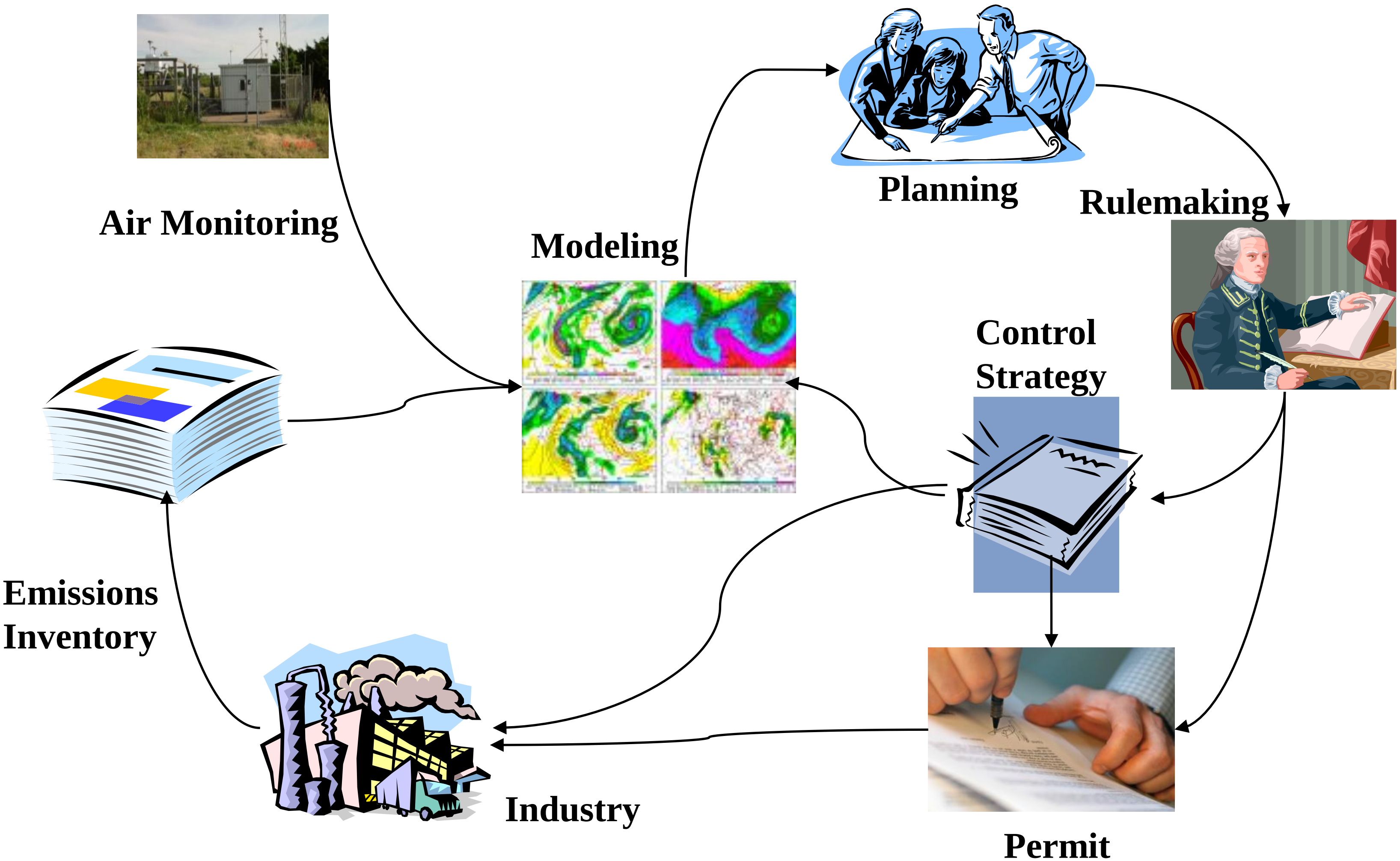
State/Local Programmatic Responsibilities

- Recommend NAAQS designations
- Developing and enforcing SIPs
  - Attainment plans
  - Maintenance plans
  - Maintaining NAAQS
  - Minor source NSR
- Enforcing NSPS
- Enforcing NESHAPS
- Developing and implementing Regional Haze
- programs
- Developing and implementing Title V program
- Providing funding match

How We Do It

- Permits
- Modeling
- Outreach, public education
- Compliance
- Enforcement
- Monitoring
- Emission Inventory
- Developing regulations
- Creating State Implementation Plans
- Other plans
- Grant programs

Air Quality Management Process for State/Local Programs



National Ambient Air Quality Standards

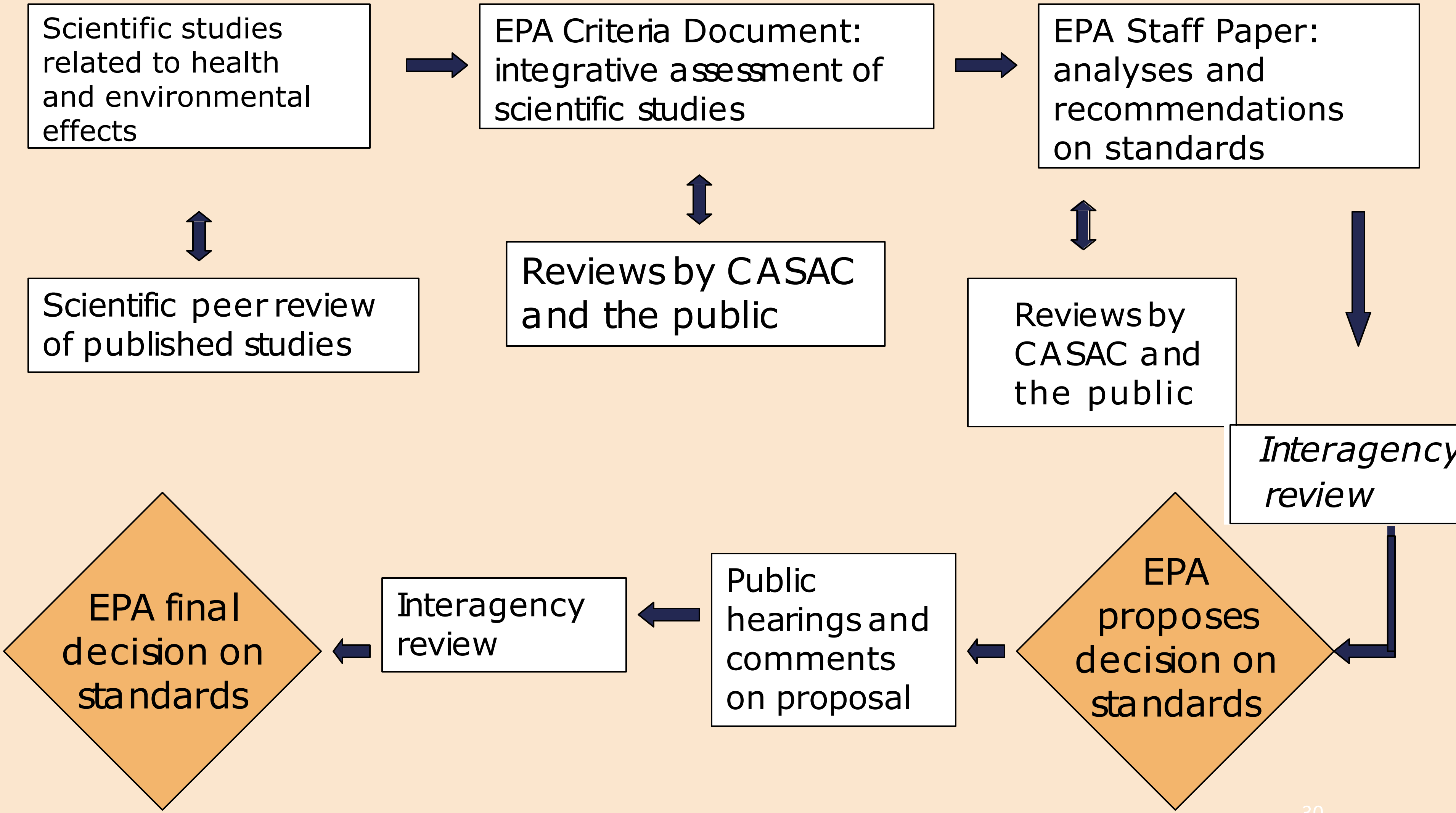
What we will cover

- What are the NAAQS?
- How are they developed?
- Health effects
- Environmental effects
- Attainment and non-attainment
- State Implementation Plans (SIPs)

Section 109 of CAA

- EPA Administrator sets primary and secondary NAAQS in accordance with criteria documents
- Criteria documents published by EPA for air pollutants that:
  - Endanger the public health or welfare
  - Result from numerous or diverse mobile and stationary sources
- Criteria documents reflect the latest scientific knowledge
- CAA requires EPA to review each pollutant every 5 years
  - Obtain advice from the Clean Air Scientific Advisory Committee
  - Currently underway for ozone and lead

EPA Process for Establishing NAAQS



NAAQS

- Since 1970, EPA has developed Criteria Documents and set NAAQS for the following pollutants:
  - Carbon Monoxide
  - Lead
  - Nitrogen Dioxide
  - Particulate Matter
    - ~~TSP~~
    - PM10
    - PM2.5
  - Ozone
  - Sulfur Dioxide
  - ~~Hydrocarbons~~
- Much of the Air Quality Program revolves around the remaining 6 "criteria pollutants"

More than one name for a pollutant

- **Criteria pollutant**: pollutants that EPA has developed human health-based and/or environmentally-based criteria
- **NAAQS**: a criteria pollutant that has an ambient air quality standard established
- **HAPS**: a pollutant listed on the list of 189 contained in Section 112 of the Clean Air Act…since revised
- **Regulated pollutant:** Once a pollutant is regulated under any provision of the Act and subject to actual control, the Prevention of Significant Deterioration (PSD) and Title V permitting programs apply to that pollutant……...GHGs

NAAQS Implementation

Link to EPA NAAQS Table : https://www.epa.gov/criteria-air-pollutants/naaqs-table

Compliance Costs and NAAQS

- CAA Sec. 109(b)
  - EPA's task is to establish standards that
    - protect public health and welfare
    - are neither more nor less stringent than necessary
  - Costs not addressed in Sec. 109
    - Whitman v. America Trucking Associations
      - in establishing standards, EPA may **not** consider the costs of implementation

How are benefits reviewed by EPA?

- Typically use photochemical modeling
  - Nature of sources of pollutant
  - Current and future precursor emissions
  - Available control strategies
- Incremental costs and benefits
- Health benefits
  - Premature mortality and morbidity
  - EPA must place a value on a human life
- All combinations used to get a range of cost and economic benefits

Primary and Secondary NAAQS

- Different considerations apply to setting NAAQS than to achieving them:
  - Setting: health and environmental effects
  - Achieving NAAQS: cost, technical feasibility, time needed to attain
- Primary standards are protective of the public health
- Secondary standards are protective of the public welfare
- So, what are the NAAQS levels for the "criteria pollutants"?

Existing NAAQS

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$ (1)	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb (2)	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 $\mu g/m^3$	annual mean, averaged over 3 years
		secondary	1 year	15.0 $\mu g/m^3$	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 $\mu g/m^3$	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

https://www.epa.gov/criteria-air-pollutants/naaqs-table

NAAQS Chart Footnotes

(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m3 as a calendar quarter average) also remain in effect.

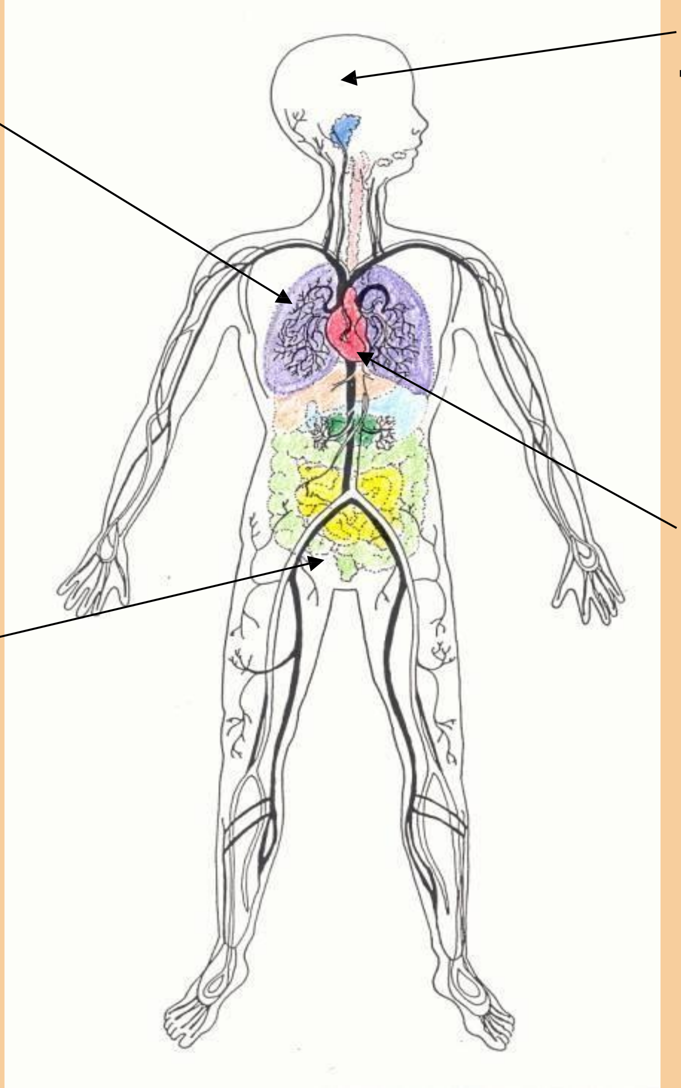
(2) The level of the annual NO2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(4) The previous SO2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)). A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required NAAQS.

Air Pollution Health Effects

Respiratory:
- Coughing, wheezing, reduced lung function
- Reduced resistance to infection
- Exacerbation of asthma, COPD
- Lung Cancer and Respiratory Mortality



Central Nervous:
- Cerebrovascular impairment
- Stroke

Cardiovascular:
- Systemic inflammation
- Autonomic system disorders
- Atherosclerosis
- Myocardial Infarctions
- Cardiovascular Mortality

Reproductive:
- Low birth weight
- Potential for preterm births and intrauterine growth retardation

Health Effects

- ***Particulate Matter*** - aggravated asthma; chronic bronchitis; reduced lung function; irregular heartbeat; heart attack; premature death in people with heart/lung disease
- ***CO*** - can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues
- ***Lead*** - affects the nervous system, kidneys, immune system, reproductive and developmental systems and cardiovascular system. Lead also affects the oxygen carrying capacity of the blood
- ***NO_2*** - airway inflammation in healthy people and increased respiratory symptoms in people with asthma
- ***SO_2*** - an array of adverse respiratory effects including bronchoconstriction and increased asthma symptoms

Ozone Health Effects

- Reduce lung function, making it difficult to breathe as deeply and vigorously as normal,
- Irritate the airways, causing coughing, sore or scratchy throat, and shortness of breath
- Inflame and damage the airways,
- Increase frequency of asthma attacks,
- Increase susceptibility to respiratory infection, and
- Aggravate chronic lung diseases such as asthma, emphysema and bronchitis.

Exposure Impacts

- At-risk groups include:
  - People with lung disease such as asthma or chronic obstructive pulmonary disease (COPD)
  - Children
  - Older adults
  - People who are more likely to be exposed, such as people who are active outdoors, including children and outdoor workers
- These effects can lead to:
  - Increased medication use among asthmatics,
  - More frequent doctors visits,
  - School absences,
  - Increased emergency room visits and hospital admissions, and
  - Increased risk of premature death in people with heart and lung disease

Environmental Effects

- ***Ozone*** - reduced growth and productivity, increased susceptibility to disease and pests, and damaged foliage
- ***Particulate Matter*** - visibility impairment, damage to building and national monuments, and damage to ecosystems
- ***CO*** – no secondary standard
- ***Lead*** - adverse effects on organisms and ecosystems
- NO_x – acidic deposition
- SO_2 – acidic deposition

Effects of Acid Rain on Plants

Area Designations

- Manner of regulating "criteria pollutants" based on whether an area is meeting the NAAQS
- Area designated is generally counties or groups of counties
- Three types of classifications (CAA Section 107):
  - Nonattainment
    - Concentration of a "criteria pollutant" exceeds the NAAQS
  - Attainment
    - Concentration of a "criteria pollutant" does not exceed the NAAQS
  - Unclassifiable
    - Concentration of a "criteria pollutant" is unknown, but presumed NOT to exceed the NAAQS
- States recommend
- EPA makes designations
  - 40 CFR Part 81

NAAQS Nonattainment

- So, what areas of the country are designated nonattainment?
- There are currently no nonattainment areas for CO or NO_2
- For the latest updates, see the following EPA website:
  - http://www.epa.gov/airquality/greenbook/
  - The following slides are from EPA's website, are current as of October 1, 2015

Interactive Maps

The Ozone Slider was created when the 2015 standard was enacted:
http://ozoneairqualitystandards.epa.gov/OAR_OAQPS/OzoneSliderApp/index.html
and the following map from the trends report may be helpful as a replacement:
https://gispub.epa.gov/air/trendsreport/2022/#naaqs_trends

The Annual Air Trends Report contains a variety of graphics that are updated annually that may be helpful (but not saved as pdf).
https://gispub.epa.gov/air/trendsreport/2022/#home

You can link to EPA maps of the nonattainment areas from within this report or by following this link:

https://epa.maps.arcgis.com/home/item.html?id=2a487fb6c56e492e8e2e66608d9b93d6#visualize

This map depicts the design values:
https://epa.maps.arcgis.com/home/item.html?id=d0d0feae2668477e8ee8de8072e11f1b

So Now You've Been Designated

- Attainment areas and unclassifiable areas
  - Assure the area does not go into nonattainment
  - CAA Title I, Part C – PSD
- Nonattainment areas
  - Get the area back into attainment
  - CAA Title I, Part D – Nonattainment NSR
- How do states implement?
  - State Implementation Plans (SIPs)

Ozone Design Value – the 3-year average of the fourth highest daily maximum 8-hour average ozone concentration measured at each monitor within an area.

Consequences of Nonattainment

- State Implementation Plan (SIP) preparation
  - Enhanced emissions inventory
  - Additional photochemical modeling
- Transportation plan conformity with SIP
- Curtails economic development
- New rules to reduce pollutant or precursor pollutants emissions
- Potential sanctions for failure to meet standard
- Increased cost for fuel, electricity, consumer products, etc.
- Citizens breathing polluted air

Designation vs. Classification

Designation means that the monitored design value for the area does not meet the current ozone standard

Classification is dependent on the numerical design value and provides the obstacle course and time limit on attaining the standard.

NOTE: Designation historically affects counties in the MSA where the exceeding monitor resides and emission reduction rules apply in them as well as counties adjacent to the MSA!

Classification Deadlines

Marginal = 3 years

Moderate = 6 years

Serious = 9 years

Severe = 15 years

Severe = 17 years

Extreme = 20 years

*CAA Sec. 181. Classifications and Attainment Dates

Classification Requirements - Marginal

Prescriptive Requirements in Clean Air Act

Major Source threshold set at 100tpy of either VOC or NOx

Emissions Inventory submittals required on industrial sources

New Source Review (NSR) permitting requirements

Permit Offsets of 1.1 to 1

Subjects projects to Transportation Conformity

Subjects projects to General Conformity (federal, non-highway projects)

Classification Requirements - Moderate

Prescriptive Requirements

Must meet Marginal Requirements and:

15% Reduction from Baseline Within 6 Years

RACT on Major Sources

Gasoline RVP of <9.0 psi

Stage II Vapor Recovery previously required – May not be needed in future

Vehicle Inspection/Maintenance Program

Permit Offsets of 1.15 to 1

Costs of Nonattainment on Industry

Non-attainment represents a “red flag” in the site selection process for both new facilities and expansions, especially for manufacturing prospects

Non-attainment involves a more complex, expensive environmental permitting process that can reduce the competitiveness of existing business and industry

Once in non-attainment, there is potential risk of significant increases in economic costs (e.g., emissions controls, penalty fees) on industry if air quality does not improve sufficiently over time

Impacts on Nonattainment on Community

Transportation and General Conformity is required to make sure that highway and construction projects do not impede the progress that the state is making toward achieving cleaner air quality.

Transportation conformity is required by the Clean Air Act to ensure that federal funding and approval are given to highway and transit projects that are consistent with the air quality goals established by a state air quality implementation plan (SIP).

Emissions budgets are established and projects must conform to those budgets.

State Implementation Plans (SIPs)

- State implementation plans (SIPs) for NAAQS
  - Infrastructure SIP (i-SIP)
  - Interstate transport
  - Attainment plans
  - Maintenance plans
- Other SIPs and SIP revisions
  - NSR: pre-construction, PSD, Nonattainment NSR
  - Regional haze
    - Initial SIP
    - Progress report – five years
    - SIP review and revision – ten years
  - VOC RACT rules, idle rule, NOx rule
  - Startup, shutdown, and malfunction (SSM)
    - Revision due in response to SIP call

Major Steps in SIP Processing

CAA or Court case mandates plan submittal, or State/Local/Tribe decides to revise its own SIP

↓

State prepares draft SIP and rules

↓

Public hearing on SIP and rules

↓

State makes appropriate revisions and adopts SIP

↓

State submits SIP to EPA Regional Office

↓

EPA reviews SIP for completeness**

↓

If complete SIP – EPA proposes approval/disapproval in CFR

↓

EPA considers public comments on SIP – approves/disapproves plan**

↓

After SIP approval, plan becomes Federally enforceable

***If mandated SIP is disapproved or a complete SIP never submitted, EPA must promulgate a Federal Implementation Plan or FIP*

Infrastructure SIPs

- CAA requires states to submit SIPs that implement, maintain, and enforce a new or revised NAAQS.
- These “infrastructure SIPs”, or “i-SIPs”, are due within 3 years after EPA issues standard.
- i-SIPs required by statutory deadline – no exceptions.
- i-SIPs must address basic requirements:
  - Ambient air quality monitoring and data systems;
  - Programs for enforcement of control measures; and
  - Adequate authority and resources to implement the plan.
- Sections 110(a)(1) and 110(a)(2)(A) – (M) specify required elements of the plan.

Infrastructure SIPs – Required i-SIP Elements

§ 110(a)(2)(A)	**Emission limits and other control measures**
§ 110(a)(2)(B)	Ambient air quality monitoring/data system
§ 110(a)(2)(C)	Programs for enforcement, PSD, and NSR
§ 110(a)(2)(D)	Interstate and international transport provisions
§ 110(a)(2)(E)	Adequate personnel, funding, and authority
§ 110(a)(2)(F)	Stationary source monitoring and reporting
§ 110(a)(2)(G)	Emergency episodes
§ 110(a)(2)(H)	Future SIP revisions
§ 110(a)(2)(I)	Nonattainment area plan or plan revision under Part D
§ 110(a)(2)(J)	Consultation with government officials, public notification, PSD, and visibility protection
§ 110(a)(2)(K)	Air quality modeling/data
§ 110(a)(2)(L)	Permitting fees
§ 110(a)(2)(M)	Consultation/participation by affected local entities

Other State Plans

- Emissions guidelines for existing sources
  - Section 111(d) plans:
    - Municipal solid waste landfills
    - Electric generating units – upcoming CO_2 standards
  - Section 111(d)/129 plan:
    - Hospital/medical/infectious waste incinerators
- EPA SIP and plan oversight authority:
  - Enforce individual SIP regs or issue SIP call
  - Federal Implementation Plan (FIP)
  - Withhold federal highway funds if lack of "conformity" between transportation plan and SIP
- Even more plans
  - Smoke management plan
  - Monitoring network plan

Developing an Attainment Plan

- Ozone is our case study
- SIP must include an attainment plan for pollutant that violates a NAAQS
- State is lead in developing attainment plan
  - Demonstrates how the area will be brought into attainment
- Plan developed through public forum
  - State, Local Agency, EPA, MPOs, businesses, environmental groups, individuals, federal, state and local transportation agencies, special interest groups
  - Many people, many meetings, many committees, many sub-committees, and plenty of opinions
- Ozone attainment plans usually rely on models supported by "weight of evidence" demonstrations

Weight of Evidence

A weight of evidence (WOE) determination examines results from a diverse set of analyses, including the outcome of the primary attainment test, and attempts to summarize the results into an aggregate conclusion with respect to whether a chosen set of control strategies will result in an area attaining the NAAQS by the appropriate year.

Sometimes the Weight of Evidence is different than what is determined by using one of the models alone.

Attainment Demonstration Modeling Exercise

- Develop modeling protocol
  - Determine models to be used
  - Episode(s) to model
  - Initial conditions
  - Boundary conditions
  - Model validation methodologies to use
- Develop emissions inventory
  - Hourly emissions rates
  - Stack data
  - Estimating area source emissions
  - Vehicle emissions
  - Natural emissions

More Exercise

- Develop inputs
- Run model
- Evaluate results
  - Compare to monitoring data
  - Statistical evaluations
  - Blame EI
  - Nudge the results
  - Repeat until everyone can live with the results
- Estimate growth through the desired attainment date
- Run model again with estimated growth

Tired of Exercising?

- Play with emission reductions until model demonstrates attainment by the attainment date
- Determine sources of emissions which need to be reduced
- Determine what strategies will achieve needed reductions
  - Point source
  - Area source
  - Motor vehicles
  - Regulations vs Incentives
  - RACT – (Reasonably Achievable Control Technology) rules
- What is politically feasible?
- http://www.epa.gov/ttn/oarpg/t1ctg.html

Developing the Attainment Plan

- Assuring successful implementation of the plan
  - Reasonable further progress (RFP)
    - Emissions inventories
    - Ambient monitoring levels
- Addressing emissions increases from expected growth
  - NA-NSR permitting
    - Major sources and major/significant modifications
    - Emissions control – Lowest Achievable Emission Rate (LAER)
    - Offsets
    - Transportation Conformity
      - Requires DOT to evaluate transportation project emissions
    - General Conformity
      - Assures that other federal activity conforms to the SIP

Maintenance Plans

- What you get when you finally meet the NAAQS
- Specifies what the state is going to do to assure continued compliance
  - No “backsliding” ……
- Specifies what you are going to do if the standard is violated after being re-designated attainment
  - Contingency measures
    - Formal document, including commitments developed
    - amended into the SIP
- Life – 10 years

Air Monitoring

Why We Monitor

Monitoring Overview

Why monitor…..doesn't modeling work?

Monitoring objectives

Air Monitoring Networks

Air Monitoring Equipment

Data Management

Quality Assurance/ Quality Control

Special Projects

Why do we monitor?

- Compliance with air quality standards
- Evaluate trends
- Determine health risk
- Establish baseline concentrations
- PSD construction permit requirement
- Model validation
- Post results to national database
- Provide Data to the public

PM 2.5 Monitor

Monitoring Objectives

- To determine highest concentrations expected to occur in an area
- To determine representative concentrations in areas of high population density
- To determine impact on ambient pollution levels of significant source categories
- To determine background concentration levels
- To evaluate trends with changes in sources

Where do we monitor?

Fixed sites

- Schools, parks, swimming pools, etc.
- Roadsides
- Platforms
- Roofs

Mobile sites

Temporary sites

Different spatial domains

40 CFR Part 58 - Siting Guidelines

https://www.govinfo.gov/content/pkg/CFR-2015-title40-vol6/pdf/CFR-2015-title40-vol6-part58.pdf

Scales of Monitoring

Microscale

- From several meters up to 100 meters

Middle Scale

- From 100 m up to about 500 m

Neighborhood

- Concentrations in air volumes from 500 m to 4 Km

Urban

- Concentrations in air volumes from 4 to 50 Km

Regional

- rural areas from tens to hundreds of Km

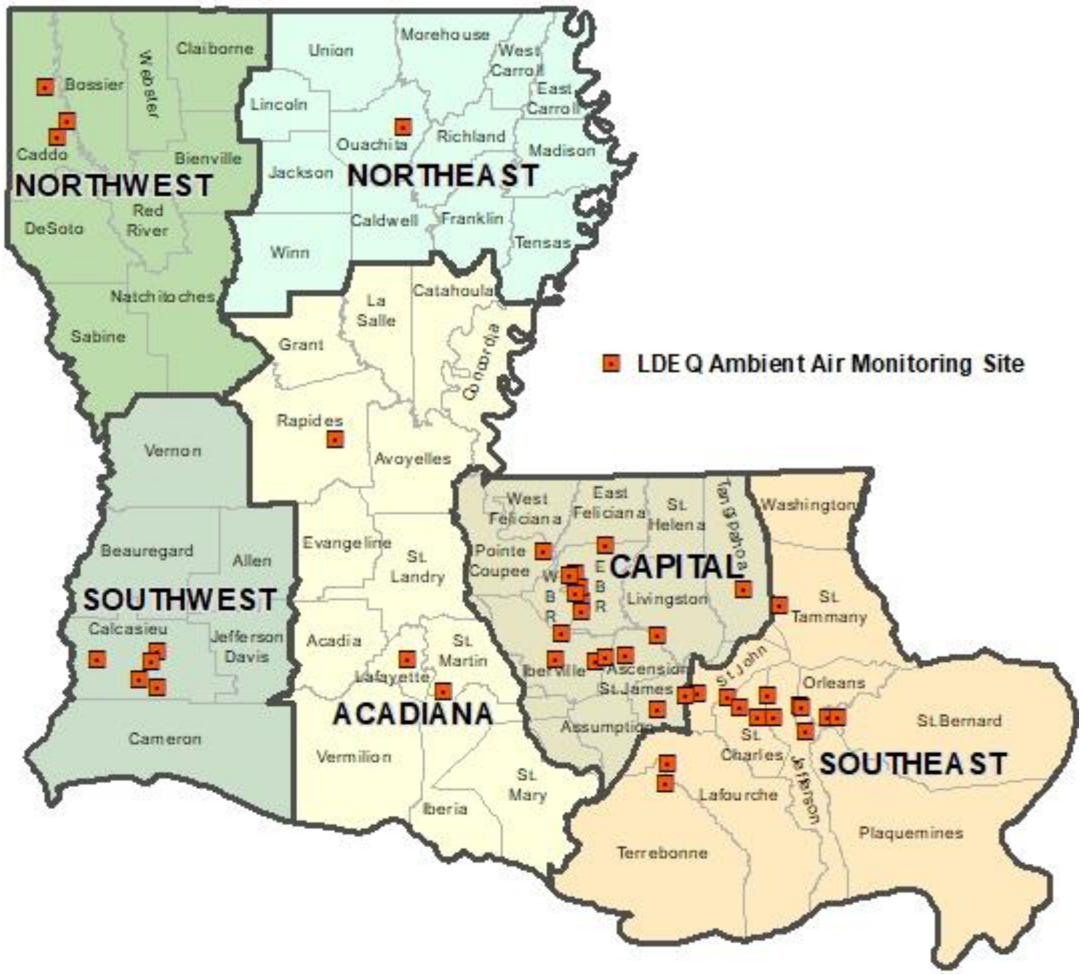
Types of Monitoring Sites

- State and Local Air Monitoring Stations (SLAMS)
- National Air Monitoring Stations (NAMS)… phased out
- National Core Monitoring Network (NCore)
- Photochemical Assessment Monitoring Stations (PAMS)
- Prevention of Significant Deterioration (PSD)
- National Atmospheric Deposition Program (NADP)
- Special Purpose Monitoring (SPM)
- Interagency Monitoring of Protected Visual Environments (IMPROVE)

Monitoring Network Design

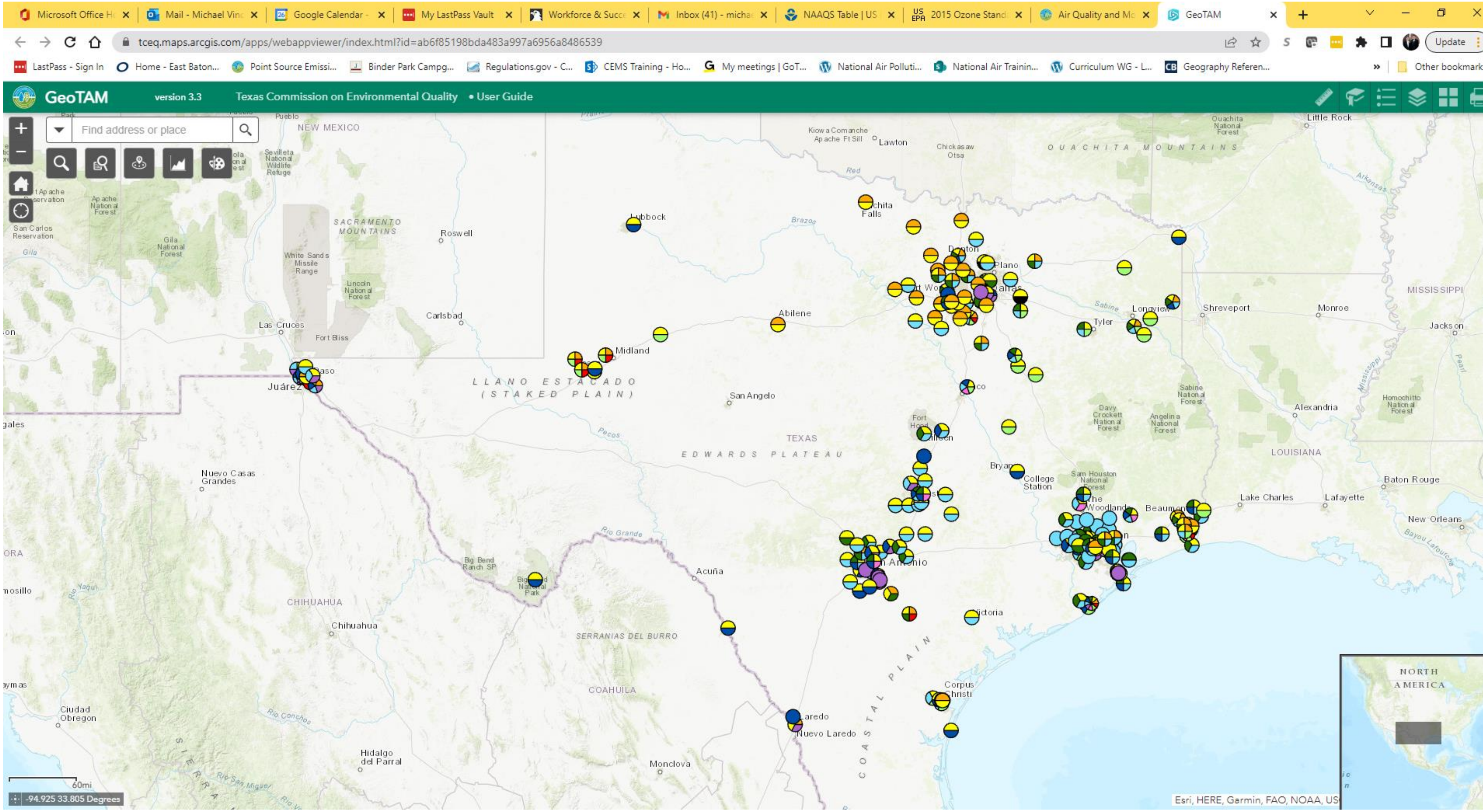
- Eventual use of the data
- Emission sources
- Meteorology - pollutant transport
- Topography or terrain
- Population centers and densities
- Available land for the site
- Station start-up costs
  - Lease arrangements and site improvements
  - Shelter and monitoring equipment
- Station operation costs
  - Equipment operation and maintenance
  - Station costs (lease payments, heating, etc..)
  - Support Personnel (spare parts, repair, etc..)

LDEQ Monitoring Sites



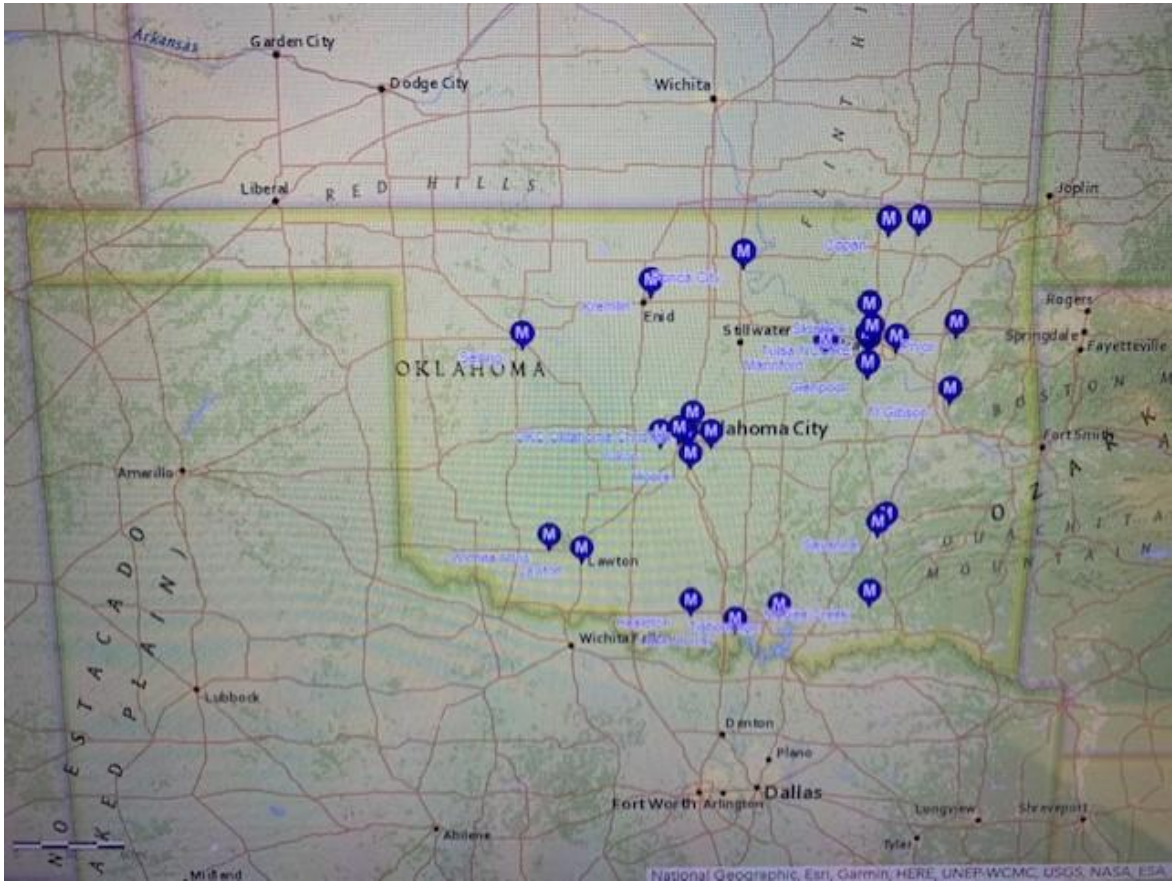
https://www.deq.louisiana.gov/page/air-monitoring-sites

TCEQ Monitoring Sites



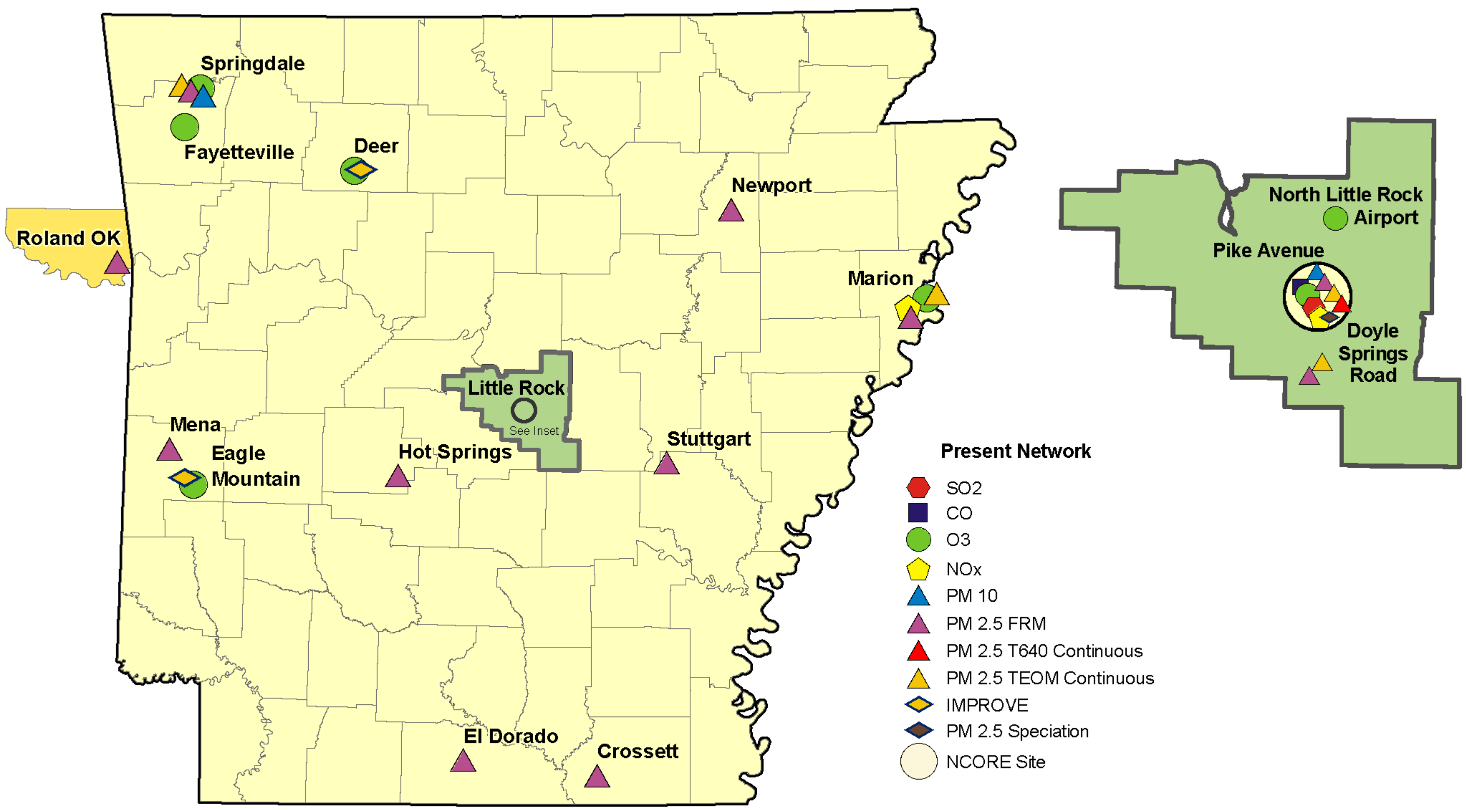
https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=ab6f85198bda483a997a6956a8486539

ODEQ Monitoring Sites

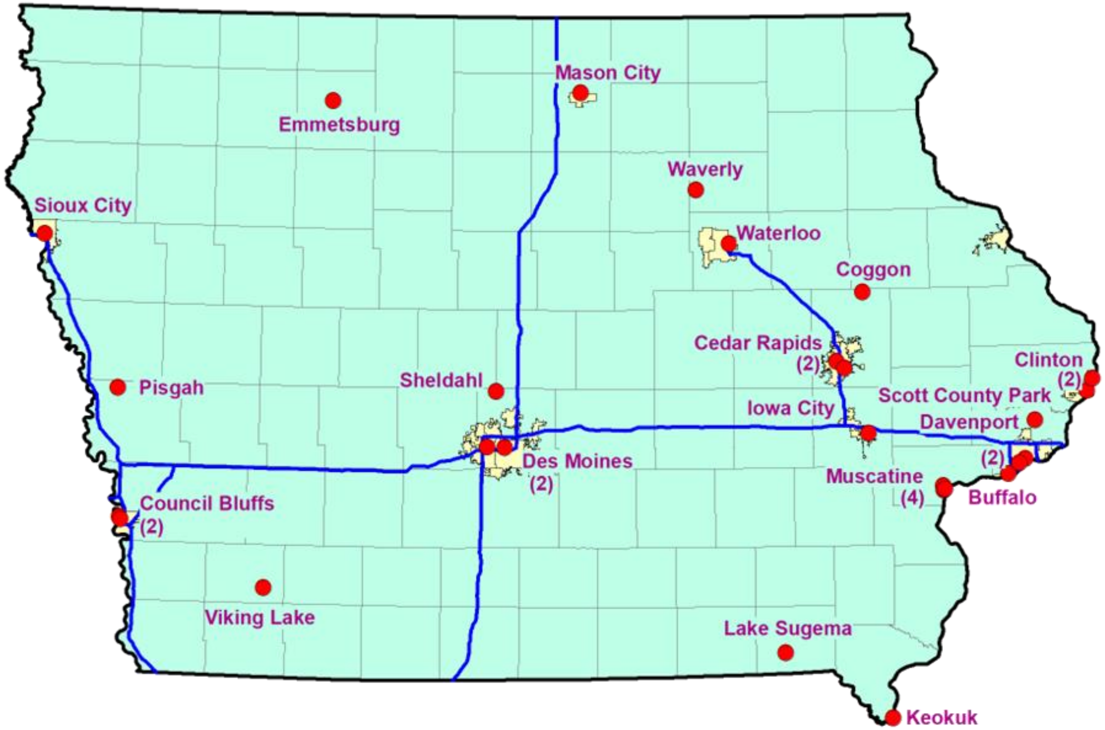


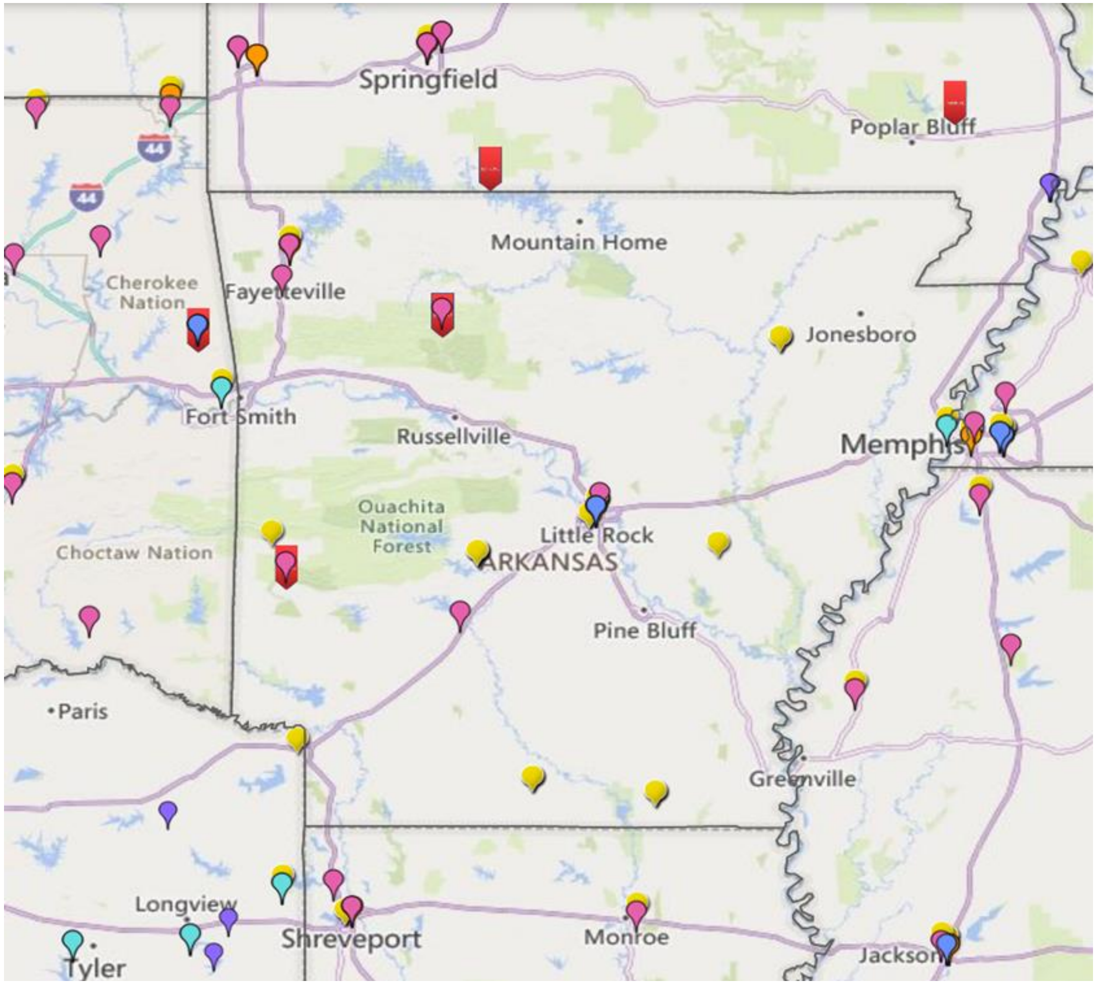
https://www.deq.ok.gov/air-quality-division/ambient-monitoring/current-air-quality-forecasts/

Arkansas Monitoring Sites



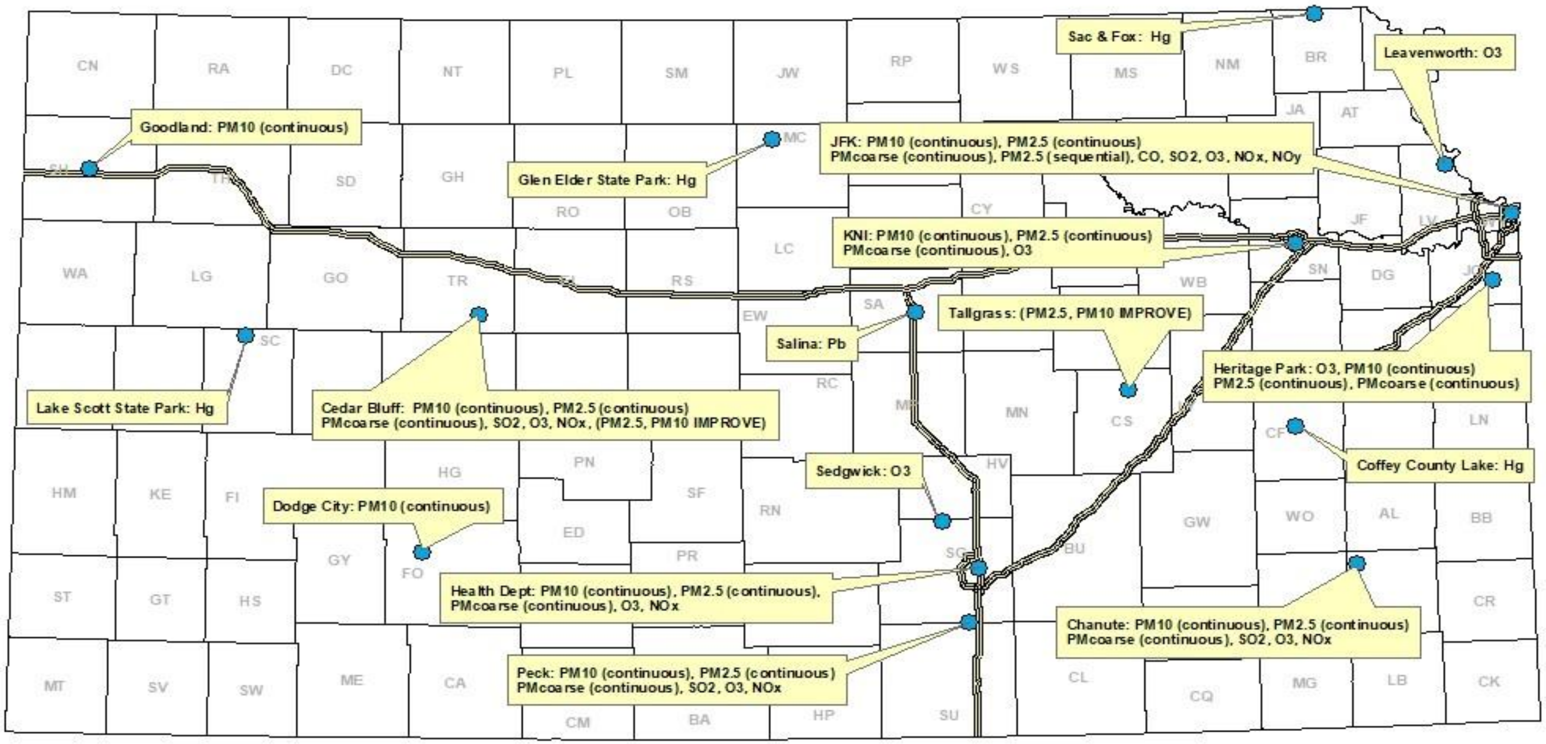
Iowa Monitoring Network





Arkansas Monitoring Network

2022 Kansas Air Monitoring Sites



What do we monitor for?

Ozone

Nitrogen Oxides

Sulfur Dioxide

Carbon Monoxide

Particulate Matter – PM10 and PM2.5
- Speciate for ions and metals

IMPROVE
- Speciate for carbon, nitrate, sulfate, ions, metals

Lead

Mercury

Meteorological conditions

Hazardous Air Pollutants

How do we monitor?

Continuous gaseous monitors
- NOx, Ozone

Filter-based particulate monitors
- TSP, PM10, PM2.5

Continuous particulate monitors
- TEOM
- BAMS
- Aethelometer
- Nephelometer
- Particle size distribution monitor

Summa canisters, PUF filters

New trend is community based monitoring with handheld devices

Examples of Handheld or Citizen Monitoring Devices

Federal reference methods

Pollutant	Reference Method
SO_2	Spectrophotometry
NO_2	Gas-phase chemiluminescence
CO	Nondispersive infrared photometry
O_3	Chemiluminescence
NMHCs	Gas chromatography – FID (flame ionization detection)
PM_{10}	Microgravimetric analysis
$PM_{2.5}$	Microgravimetric analysis

Federal Regulations and Guidance

- 40 CFR 50 - NAAQS
- 40 CFR 53 – Reference and equivalent methods
- 40 CFR 58 – Monitoring criteria
- Quality Assurance Handbook for Air Pollution Measurement Systems - "Red Book"
- The "Green Book" – Nonattainment areas
- https://www3.epa.gov/ttnamti1/files/ambient/pm25/qa/Final%20Handbook%20Document%201_17.pdf

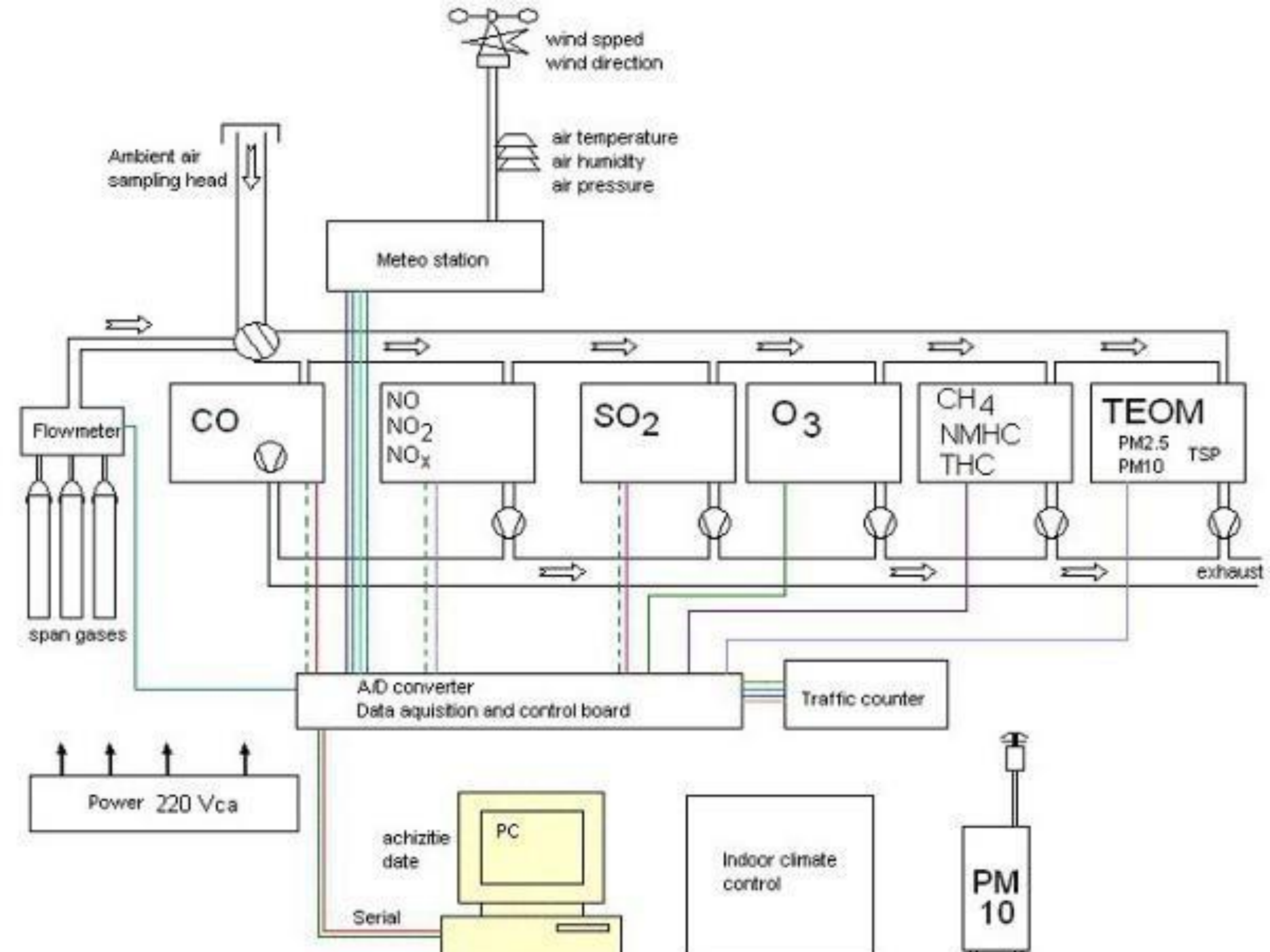
QA/QC

QA Examples:

- Technical System Audits
- Network Reviews, Corrective Action Requests
- Data Certification Reports

QC Examples:

- Mislabeling of samples
- Faulty Certifications
- Not following SOPs



wind spped
wind direction
air temperature
air humidity
air pressure
Ambient air
sampling head
Meteo station
Flowmeter
CO
NO
NO2
NOx
SO2
O3
CH4
NMHC
THC
TEOM
PM2.5
PM10
TSP
exhaust
span gases
A/D converter
Data aquisition and control board
Traffic counter
Power 220 Vca
achizitie
date
PC
Serial
Indoor climate
control
PM
10

El Paso Chamizal

800 S. San Marcial Street, El Paso, Texas, El Paso County; AQS#481410044

Houston Deer Park #2

4514 ½ Durant Street, Houston, Texas, Harris County; AQS#482011039

LSU Monitoring Site

Monitoring Site Inlet

Teflon tubing lines connect the sample inlet to the valves inside the trailer.

(Location: Houston Deer Park #2)

Rack Mounted Gaseous Samplers

Several gaseous parameters are measured at the NCore sites, including ozone, direct nitrogen dioxide (NO2), trace sulfur dioxide (SO2), trace carbon dioxide (CO2), and highly reactive oxides of nitrogen (NOy). Each one of these pollutant analyzers works in conjunction with a calibrator and verified source gas.

(Location: El Paso Chamizal)

Electromagnetic Valves

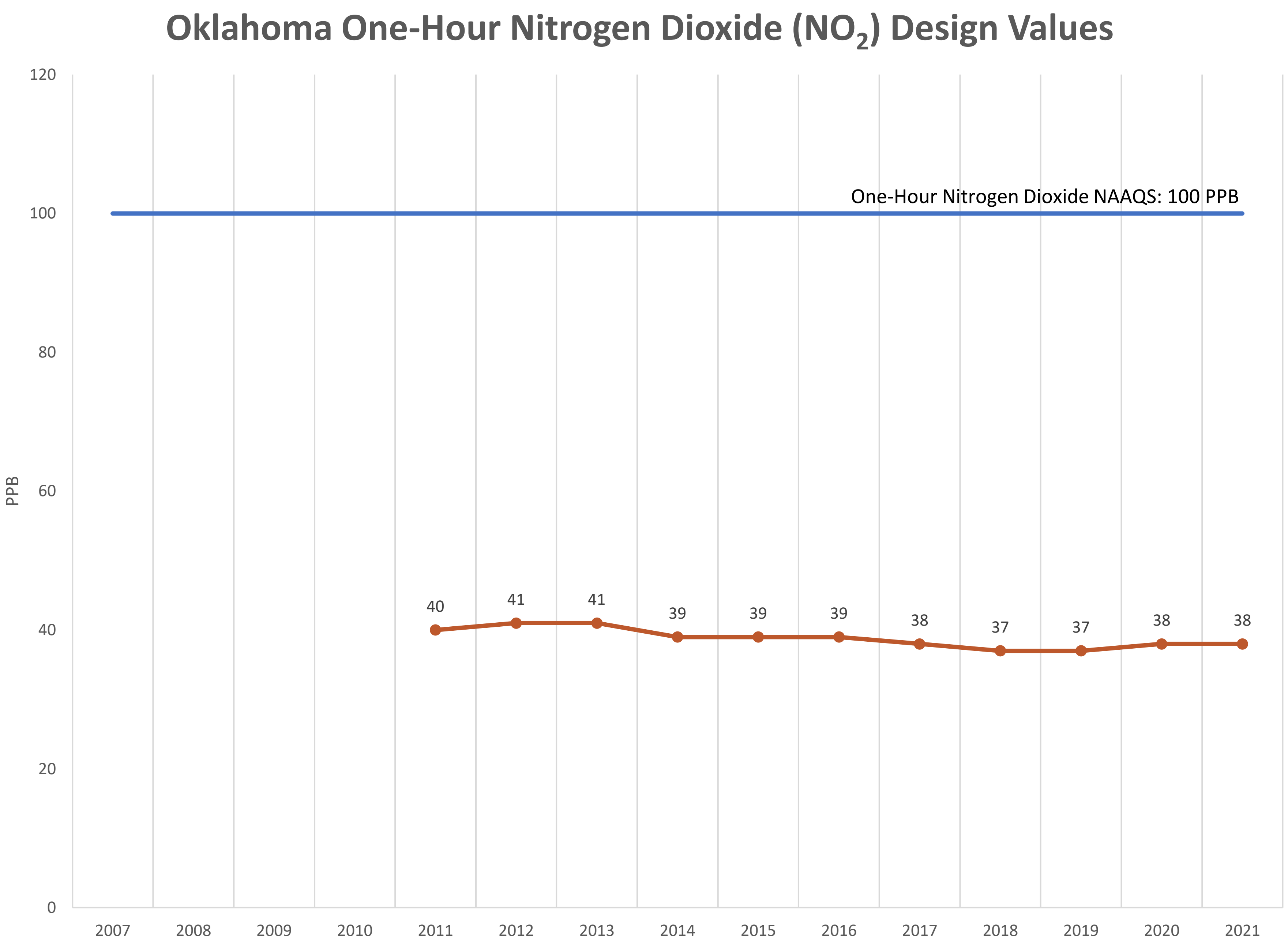
Nitrogen Dioxide

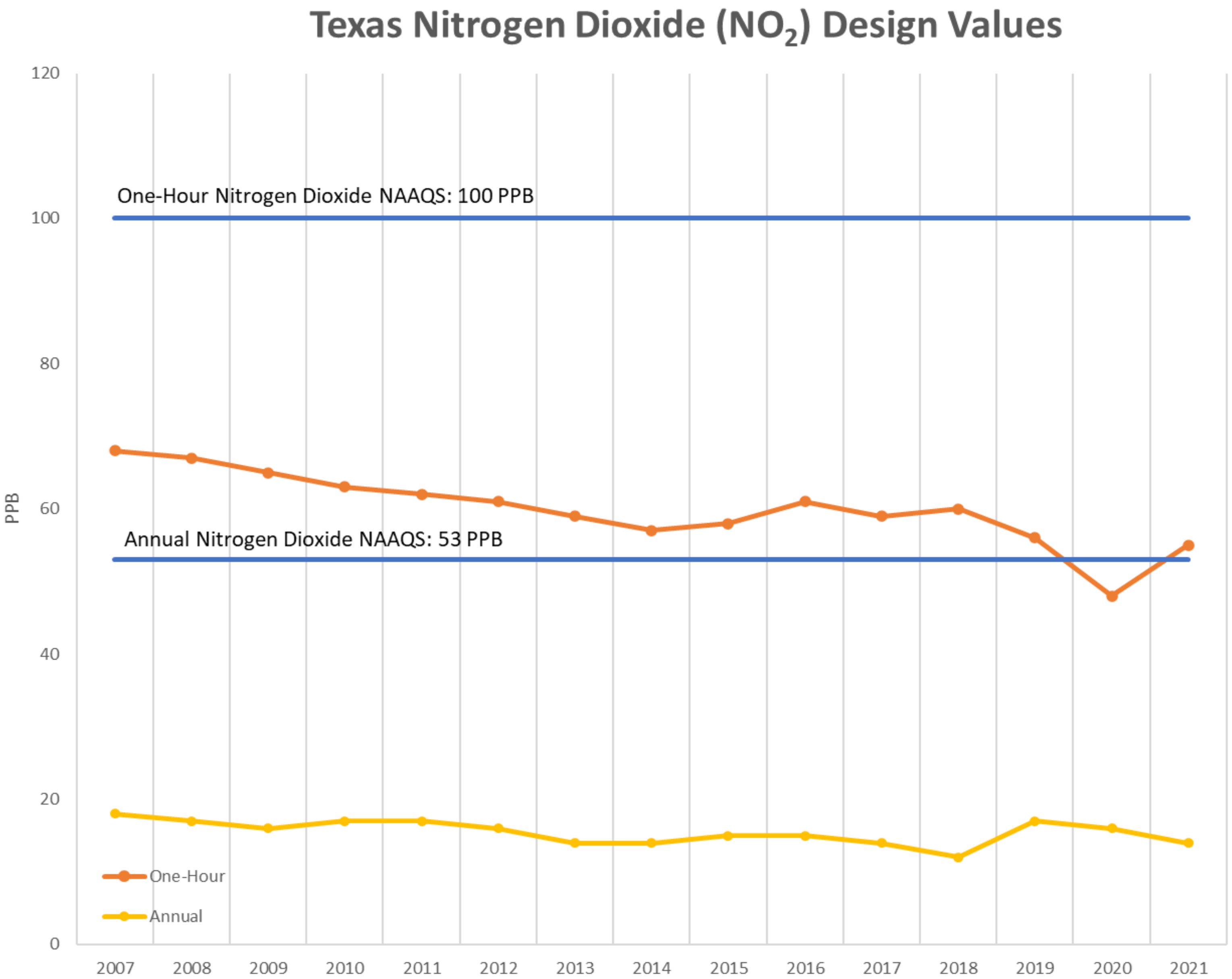
- Nitrogen Dioxide NAAQS
  - 100 ppb 1-hour Average
  - 53 ppb Annual Average
- Sources: motor vehicle exhaust, heat & power generation, fertilizer manufacture
- Primary concern with NO_x is as a precursor to ozone and $PM_{2.5}$

On January 20, 2012 EPA designated all areas of the country as "unclassifiable/attainment" for the 2010 NO2 NAAQS. The available air quality data show that all monitored areas in the country meet the 2010 NO2 NAAQS for 2008-2010. No state or tribe recommended an area be designated "nonattainment.

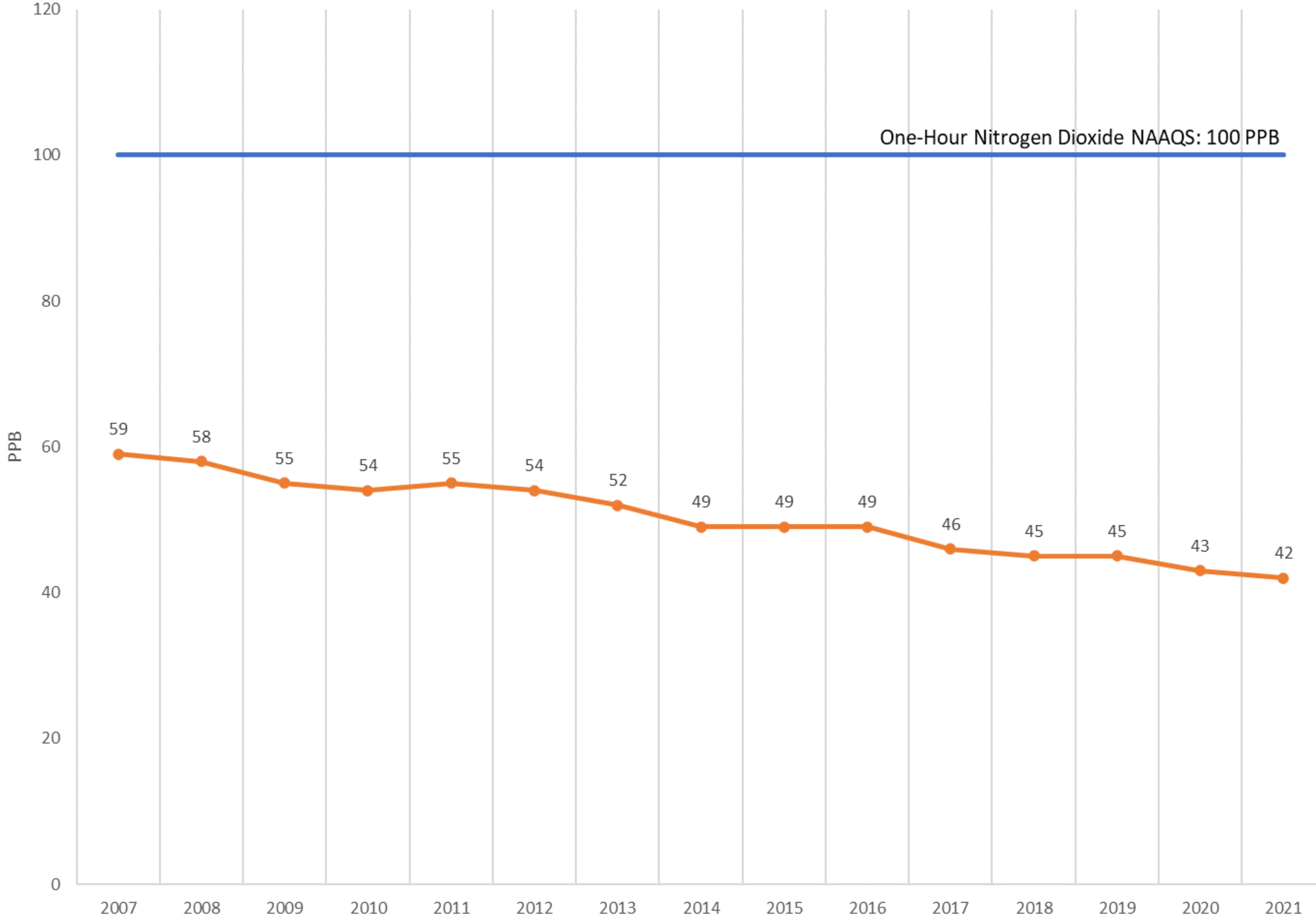
Nitrogen Dioxide Method

- Monitored indirectly by monitoring total oxides of nitrogen
  - Gas Phase Chemiluminescence: emission of light from electronically excited chemical species formed in chemical reactions.
  - $NO + O_3 \longrightarrow NO_2 + h\nu$ (300 - 500 nm)
  - Flow alternates between catalytic converter and no conversion
  - Reduce NO_2 to NO in converter
  - Measure NO and NOx alternately
  - Calculate NO_2 by difference (NOx - NO)


Oklahoma One-Hour Nitrogen Dioxide (NO_2) Design Values
One-Hour Nitrogen Dioxide NAAQS: 100 PPB
PPB
0
20
40
60
80
100
120
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
40
41
41
39
39
39
38
37
37
38
38

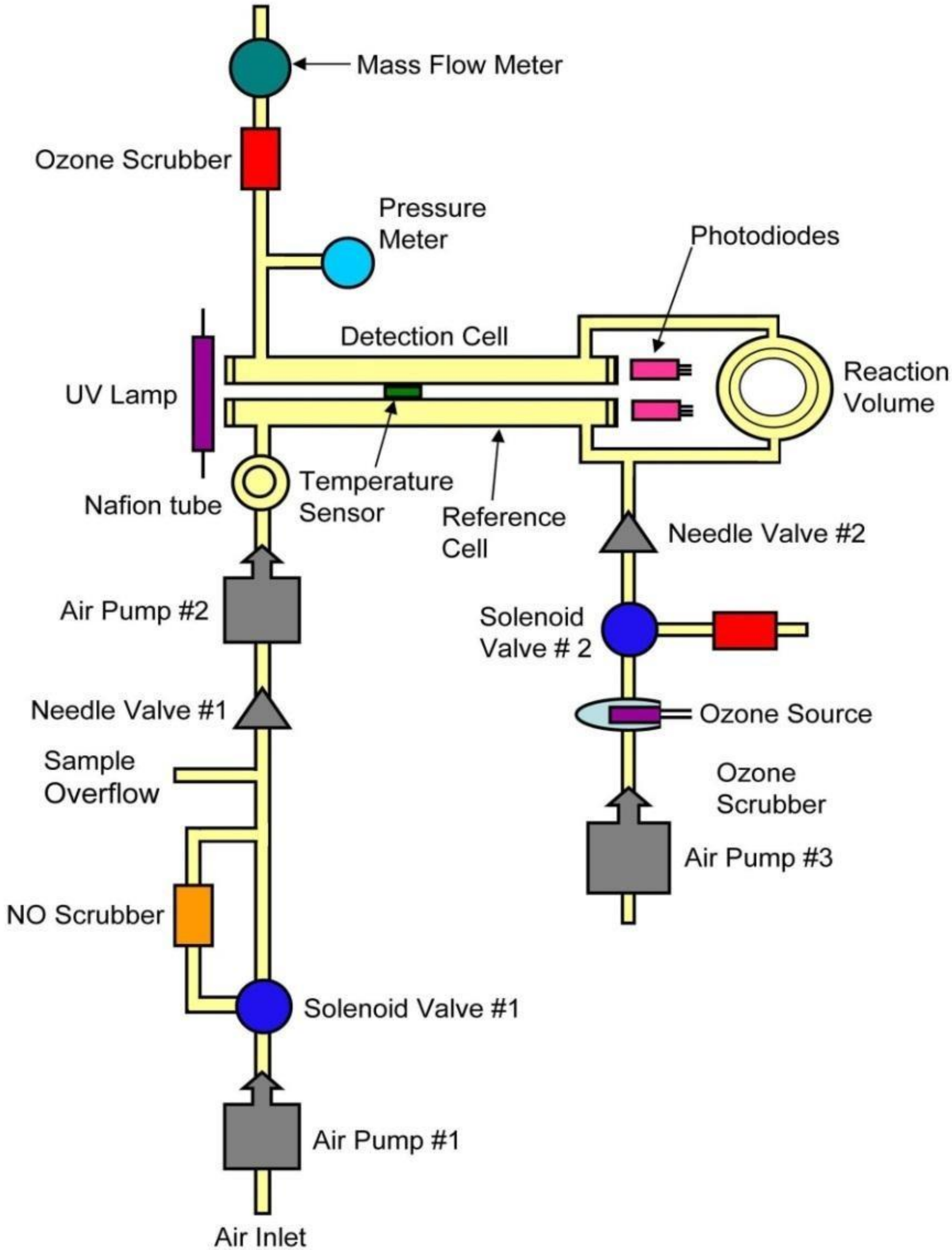

Texas Nitrogen Dioxide (NO_2) Design Values
One-Hour Nitrogen Dioxide NAAQS: 100 PPB
Annual Nitrogen Dioxide NAAQS: 53 PPB
PPB
120
100
80
60
40
20
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
One-Hour
Annual

Louisiana One-Hour Nitrogen Dioxide (NO_2) Design Values

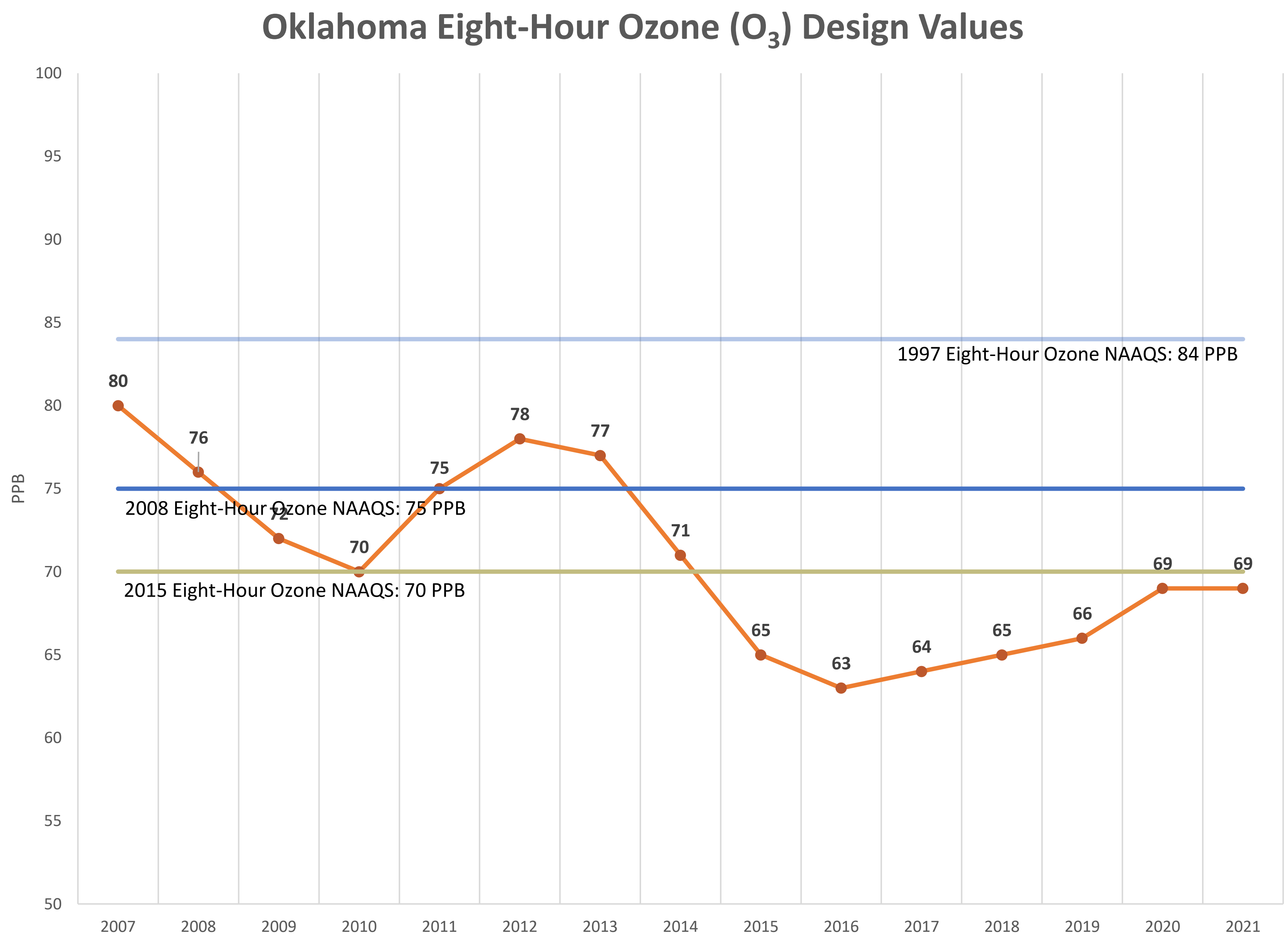


Ozone

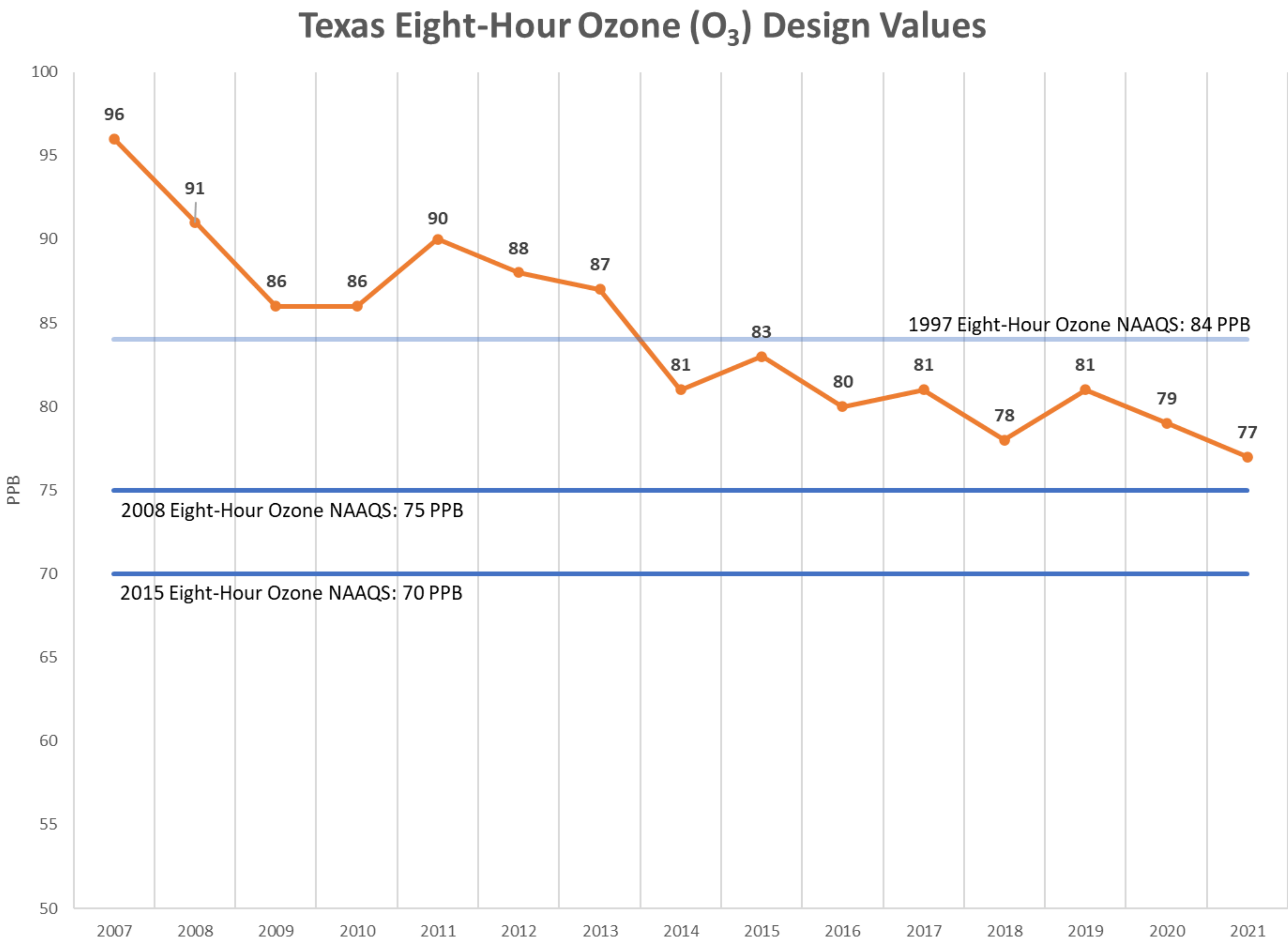
- Ozone NAAQS
  - 0.070 ppm 8 hour Average (current standard)
- Sources
  - Secondary Pollutant: No industrial sources
  - Formed in the atmosphere by the photochemical reaction of NOx and VOCs
- Analyzers measure amount of UV absorbed by molecular ozone (ultraviolet photometry)
  - Use a mercury lamp (UV source)
  - Analytical wavelength = 254 nm



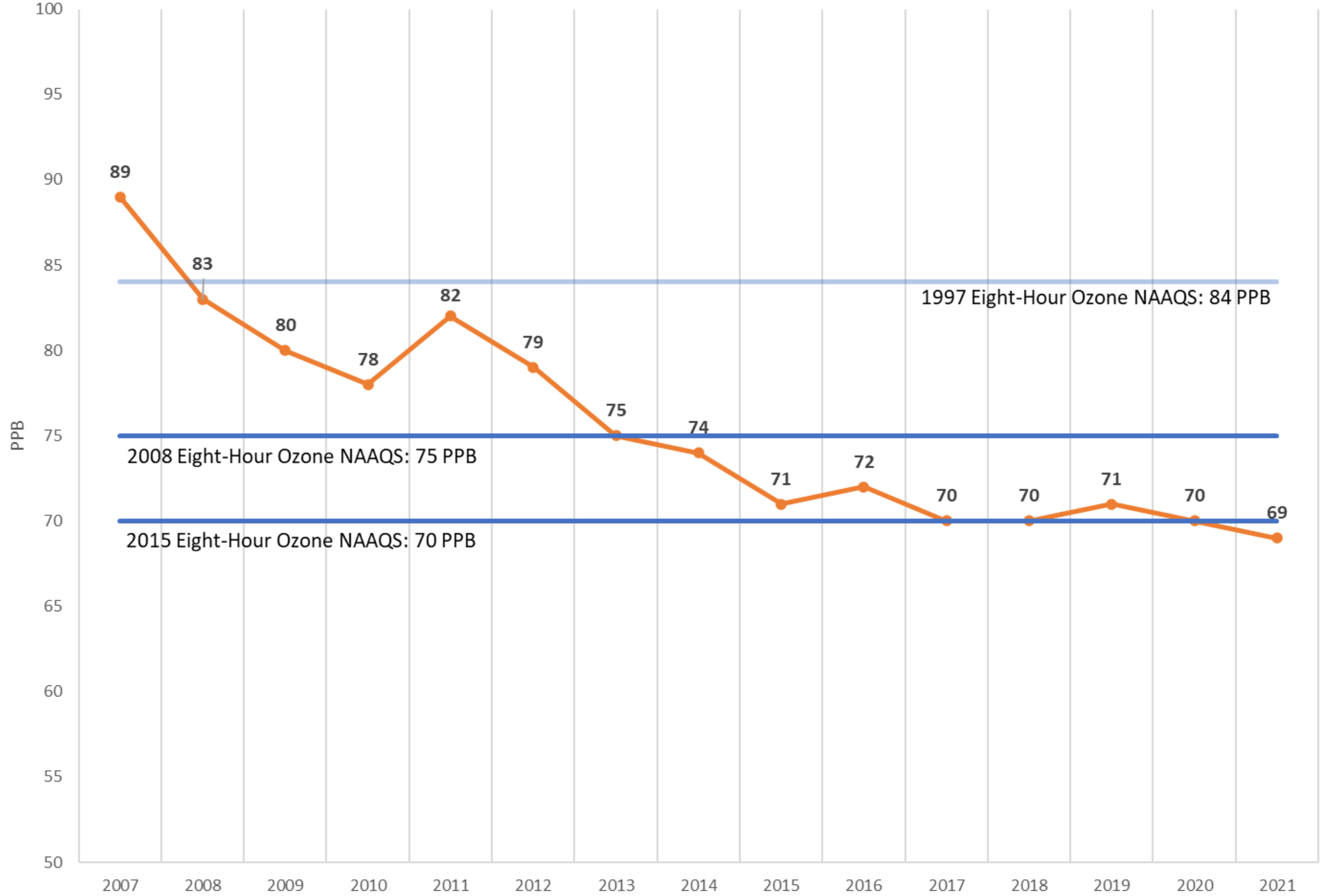
Ozone Method



Oklahoma Eight-Hour Ozone (O_3) Design Values
PPB
100
95
90
85
80
75
70
65
60
55
50
1997 Eight-Hour Ozone NAAQS: 84 PPB
2008 Eight-Hour Ozone NAAQS: 75 PPB
2015 Eight-Hour Ozone NAAQS: 70 PPB
80
76
72
70
75
78
77
71
65
63
64
65
66
69
69
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

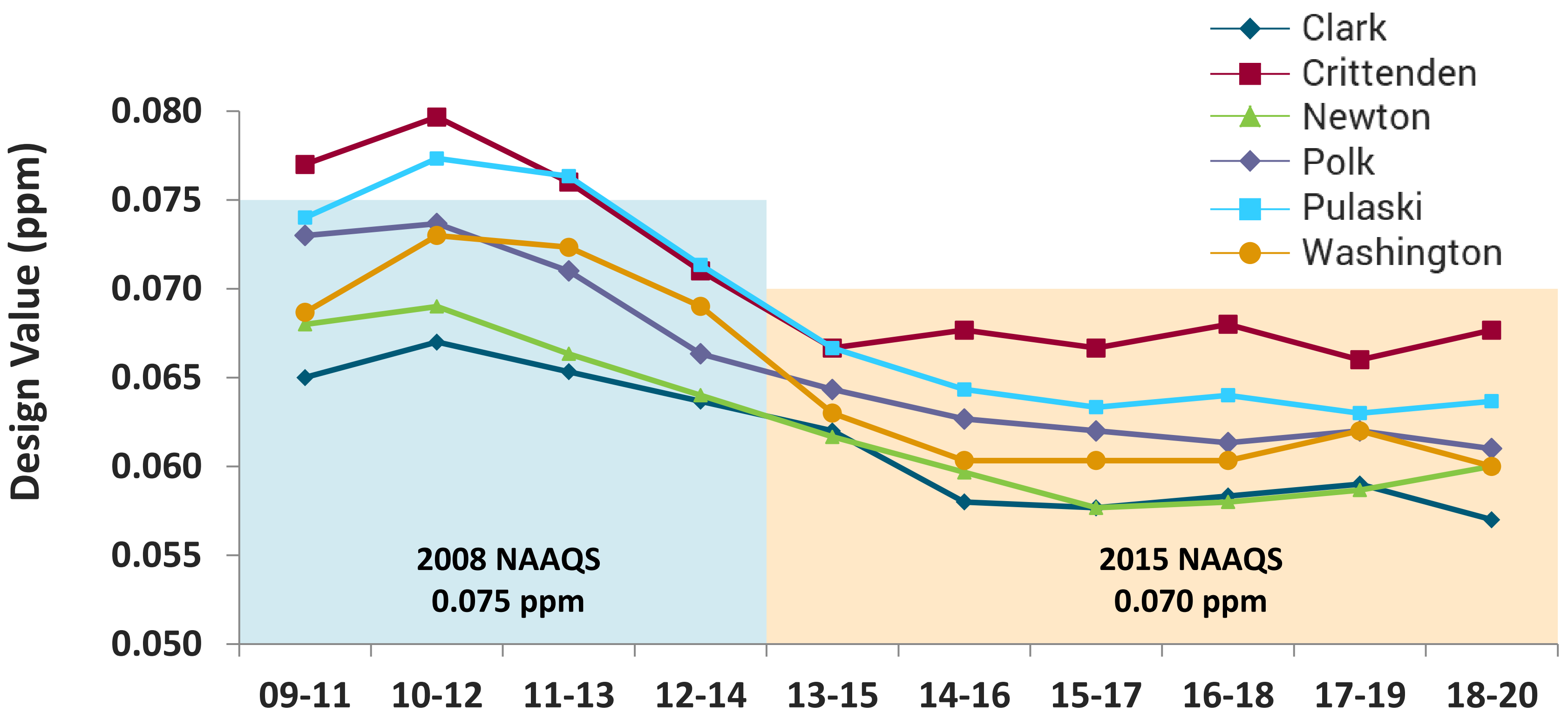

Texas Eight-Hour Ozone (O_3) Design Values
100
95
90
85
80
75
70
65
60
55
50
PPB
96
91
86
86
90
88
87
83
81
80
81
78
81
79
77
1997 Eight-Hour Ozone NAAQS: 84 PPB
2008 Eight-Hour Ozone NAAQS: 75 PPB
2015 Eight-Hour Ozone NAAQS: 70 PPB
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Louisiana Eight-Hour Ozone (O_3) Design Values



Arkansas Eight-hour Ozone Design Value Trends

2009 - 2020

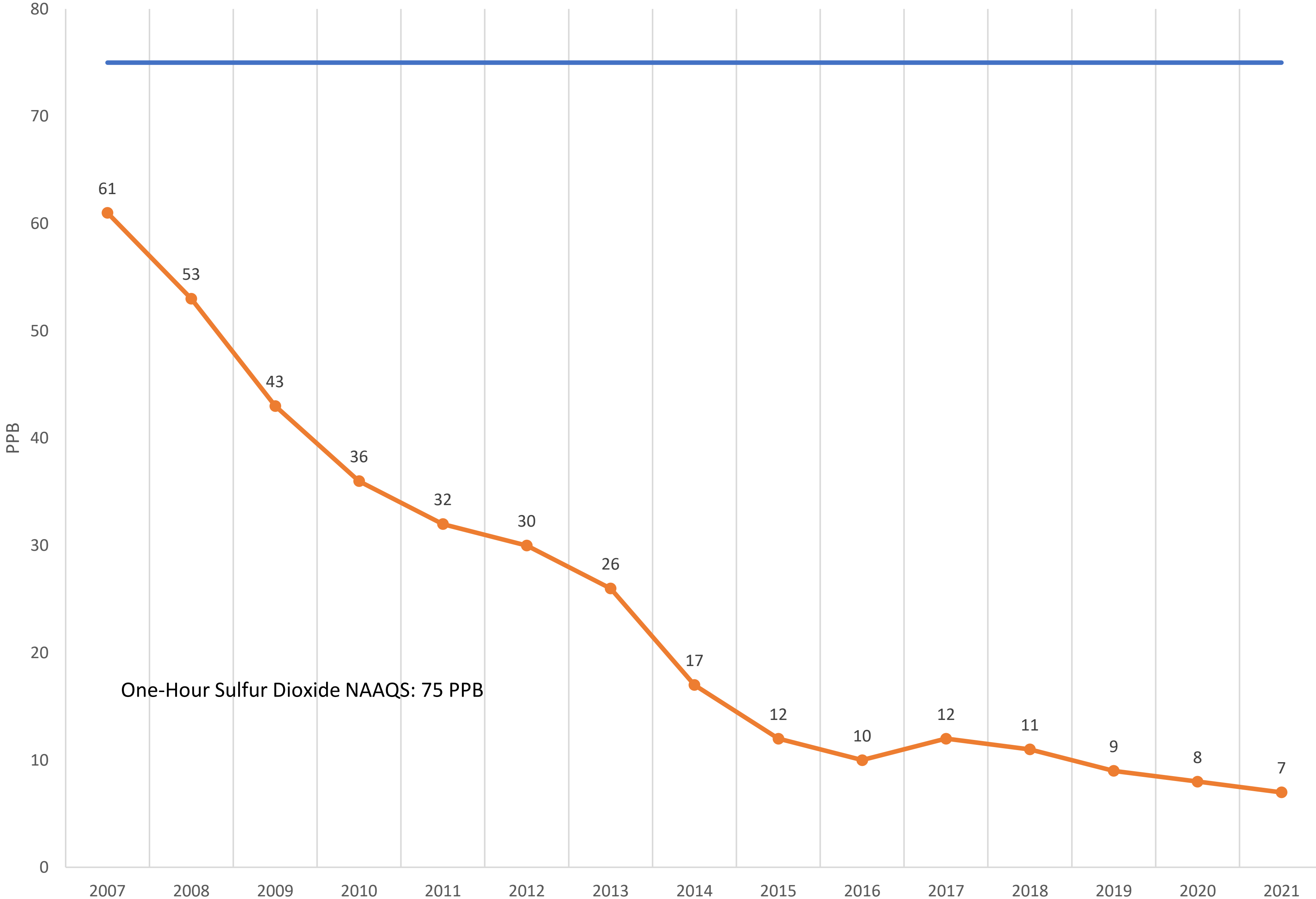


Category	AQI Value	1997 8-hour (ppm)	2008 8-hour (ppm)	2015 8-hour (ppm)
Good	0-50	0.000-0.064	0.000-0.059	0.000-0.054
Moderate	51-100	0.065-0.084	0.060-0.075	0.055-0.070
Unhealthy for Sensitive Groups	101-150	0.085-0.104	0.076-0.095	0.071-0.085
Unhealthy	151-200	0.105-0.124	0.096-0.115	0.086-0.105
Very Unhealthy	201-300	0.125-0.374	0.116-0.374	0.106-0.200

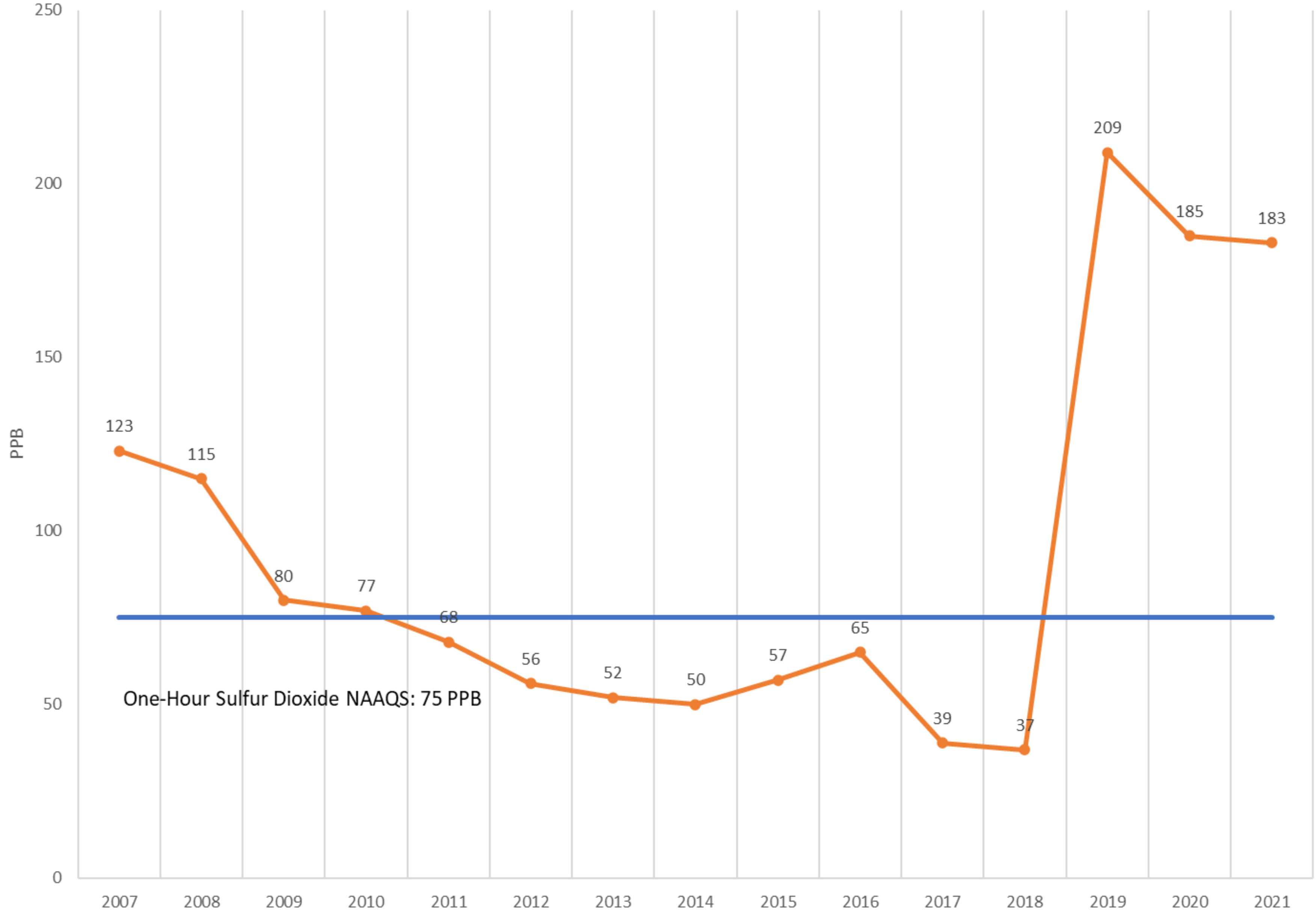
Sulfur Dioxide

- Sulfur Dioxide NAAQS
  - 75 ppb 1-hour average
  - 0.5 ppm 3-hour average
- Sources
  - Smelters, sulfur in fuel combustion (heat & power generation), petroleum refining
- Analyzers measure fluorescence emitted by SO_2 subjected to UV light
- Analyzers
  - Fluorescence analyzers
  - UV excitation light (210 nm)
  - Measure emitted light (350 nm)

Oklahoma One-Hour Sulfur Dioxide (SO_2) Design Values

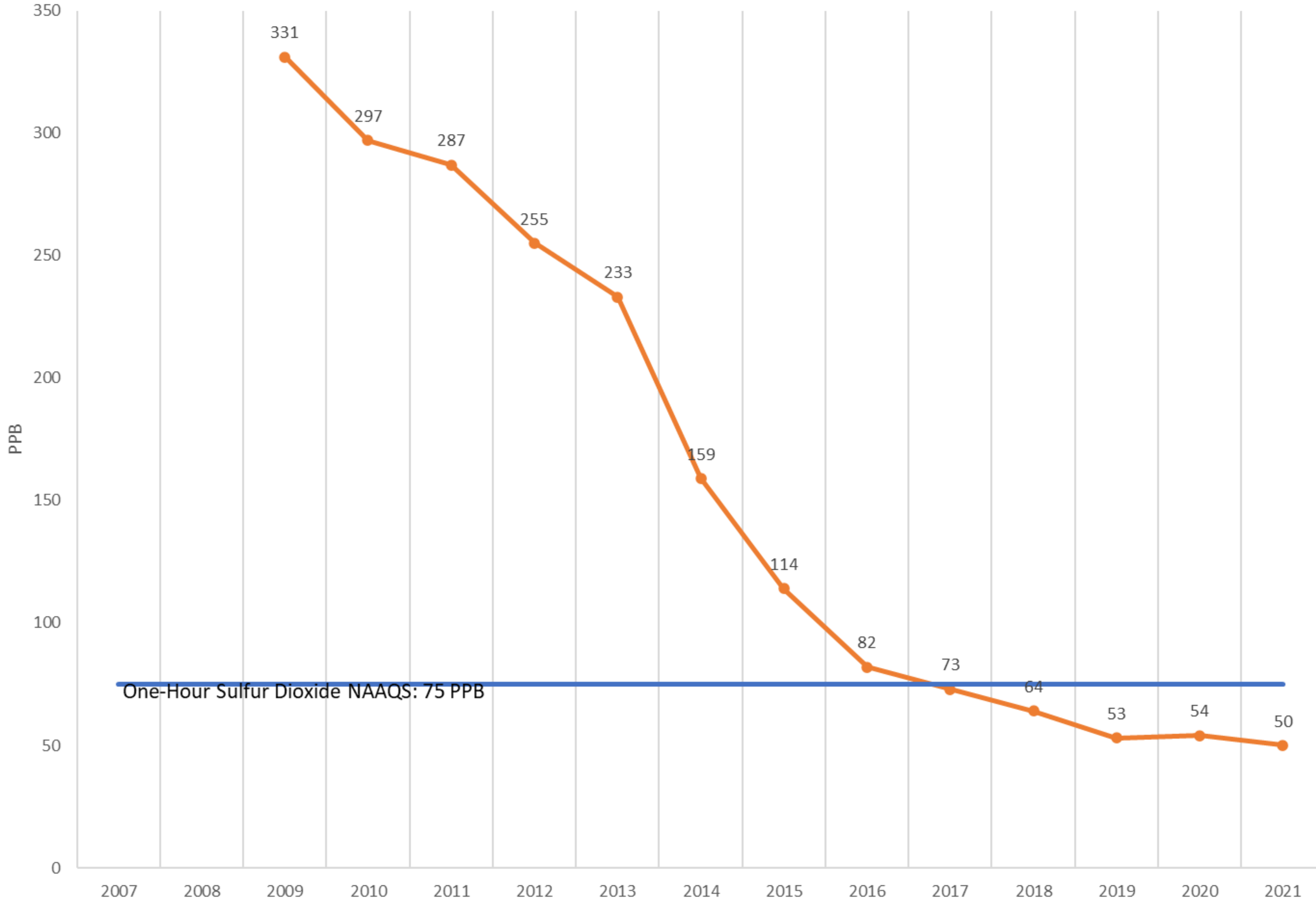


Texas One-Hour Sulfur Dioxide (SO_2) Design Values

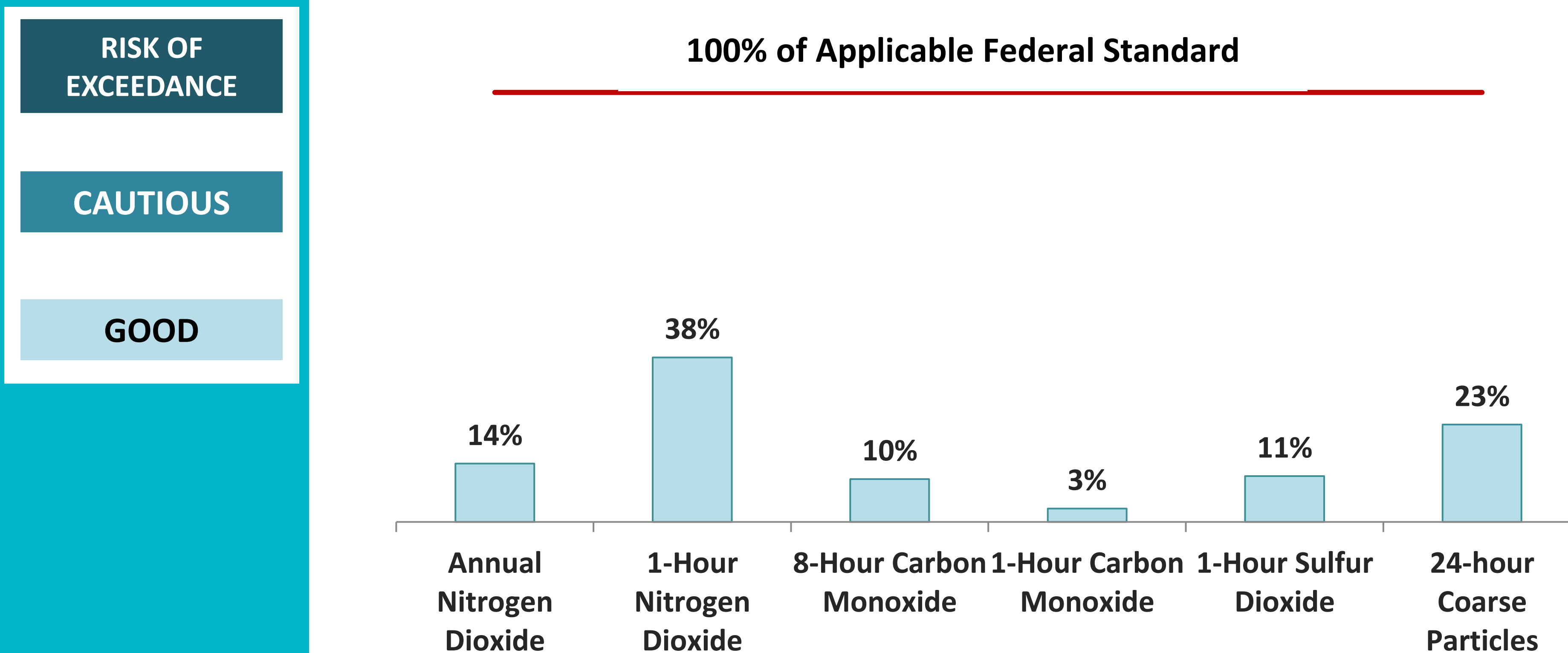


https://www.tceq.texas.gov/airquality/airsuccess/airsuccesscriteria

Louisiana One-Hour Sulfur Dioxide (SO_2) Design Values



Statewide Average Design Values Compared to NAAQS for Other Criteria Pollutants



Particulate Matter

- $PM_{2.5}$ NAAQS
  - 12 µg/m^3 Annual Average - primary
  - 15 µg/m^3 Annual Average - secondary
  - 35 µg/m^3 24 hour Average
- PM_{10} NAAQS
  - 150 µg/m^3 24 hour Average
- Sources
  - Wind blown dust, re-entrained dust, secondary reactions in atmosphere with ammonia, nitrates & sulfates. Direct emissions from combustion.
- Measured with microgravimetric filter analysis or beta ray attenuation methods
- EPA directed by court to reconsider secondary $PM_{2.5}$

Particulate Pollutants

PM_{10} sampler with size-selective inlet

- Impaction and filtration are the primary PM collection principles
- Measure the weight of exposed and clean filters
- High-volume sampler (Hi-Vol)
- Typical sampling duration – 24 hours

PM_{10} Sampler

- Remove particles > 10 μm by impaction on a greased surface
- Particles < 10 μm collected on a quartz glass fiber filter

PM2.5 Filter Cassettes

PM10 Filter Housing

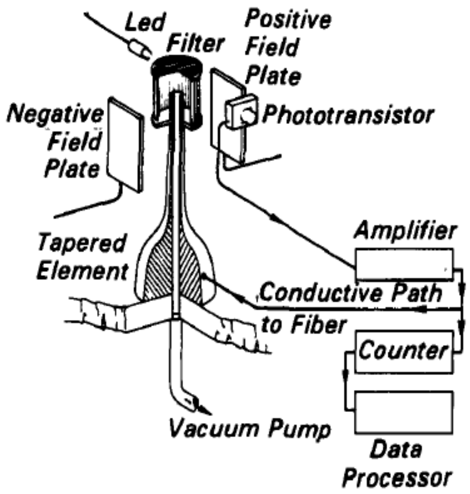
Particulate Monitoring Platform

(Clockwise from top left: Thermo Partisol Plus 2025 Sequential Air Sampler; Met One Beta Attenuation Monitor (BAM) 1020 Sampler; URG-3000N Sequential Particulate Speciation System; Met One Super SASS PM2.5 Ambient Speciation Sampler.)

TEOM Sampler

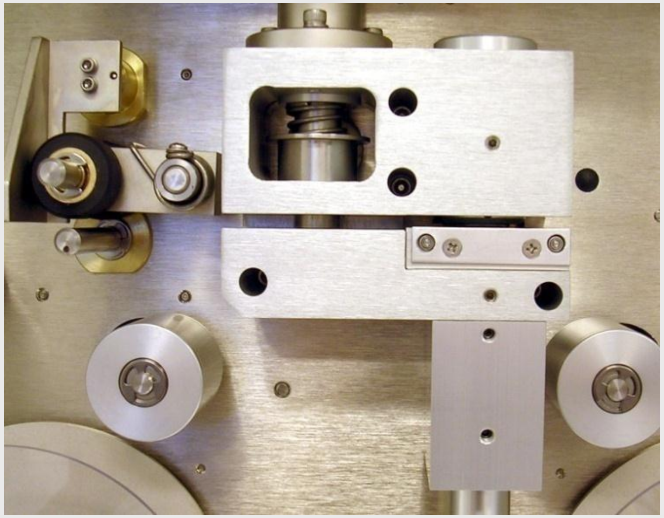
Equivalent method: TEOM

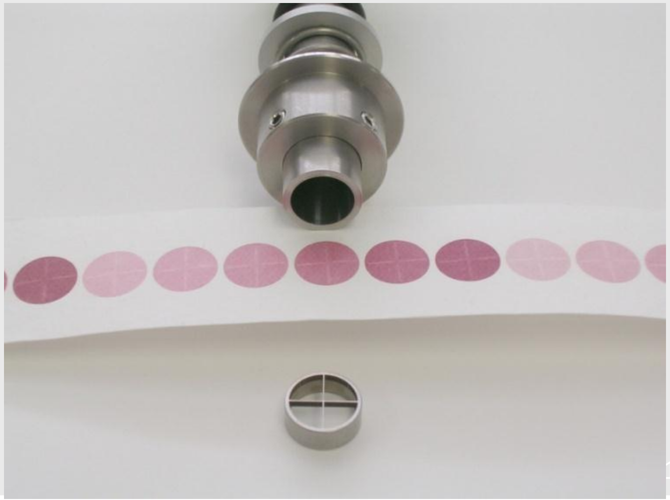
- Measure PM10, PM2.5, TSP
- Tapered element oscillating microbalance
- Real-time measurement of particle mass collected on a filter

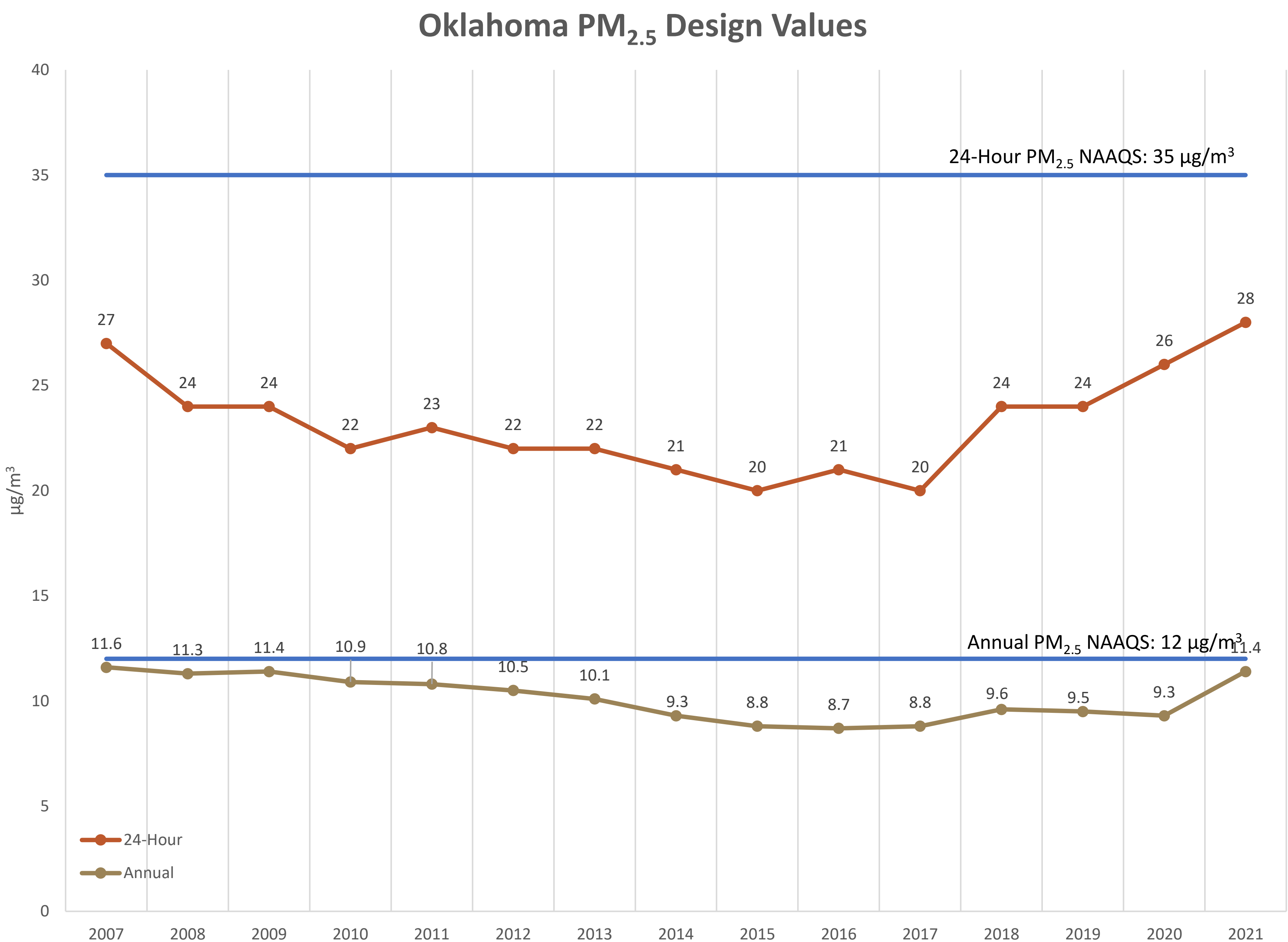


TEOM Series 1400ab Ambient Particulate Monitor Thermo Electron Co.

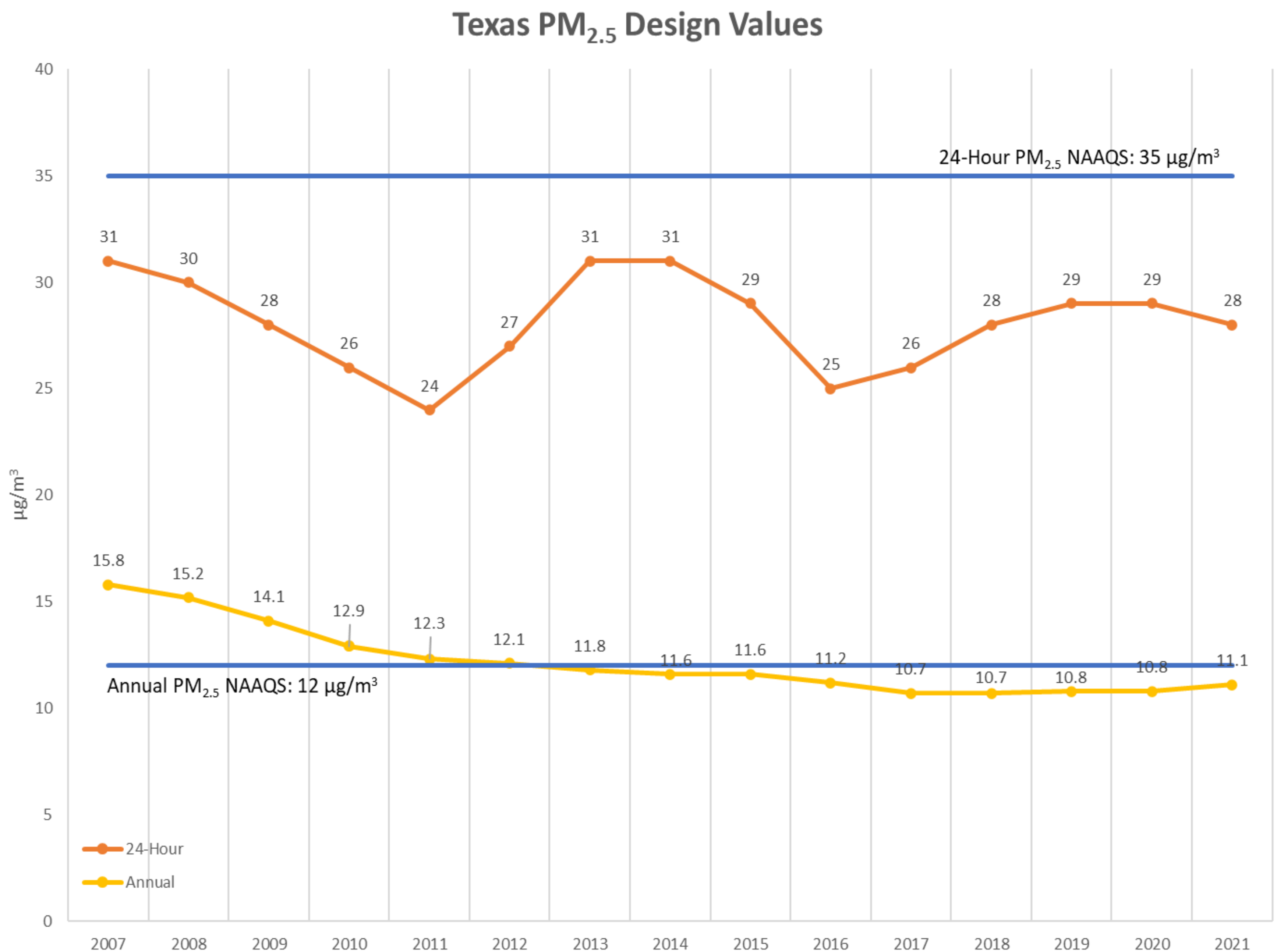
PM10 by Beta Attenuation Method





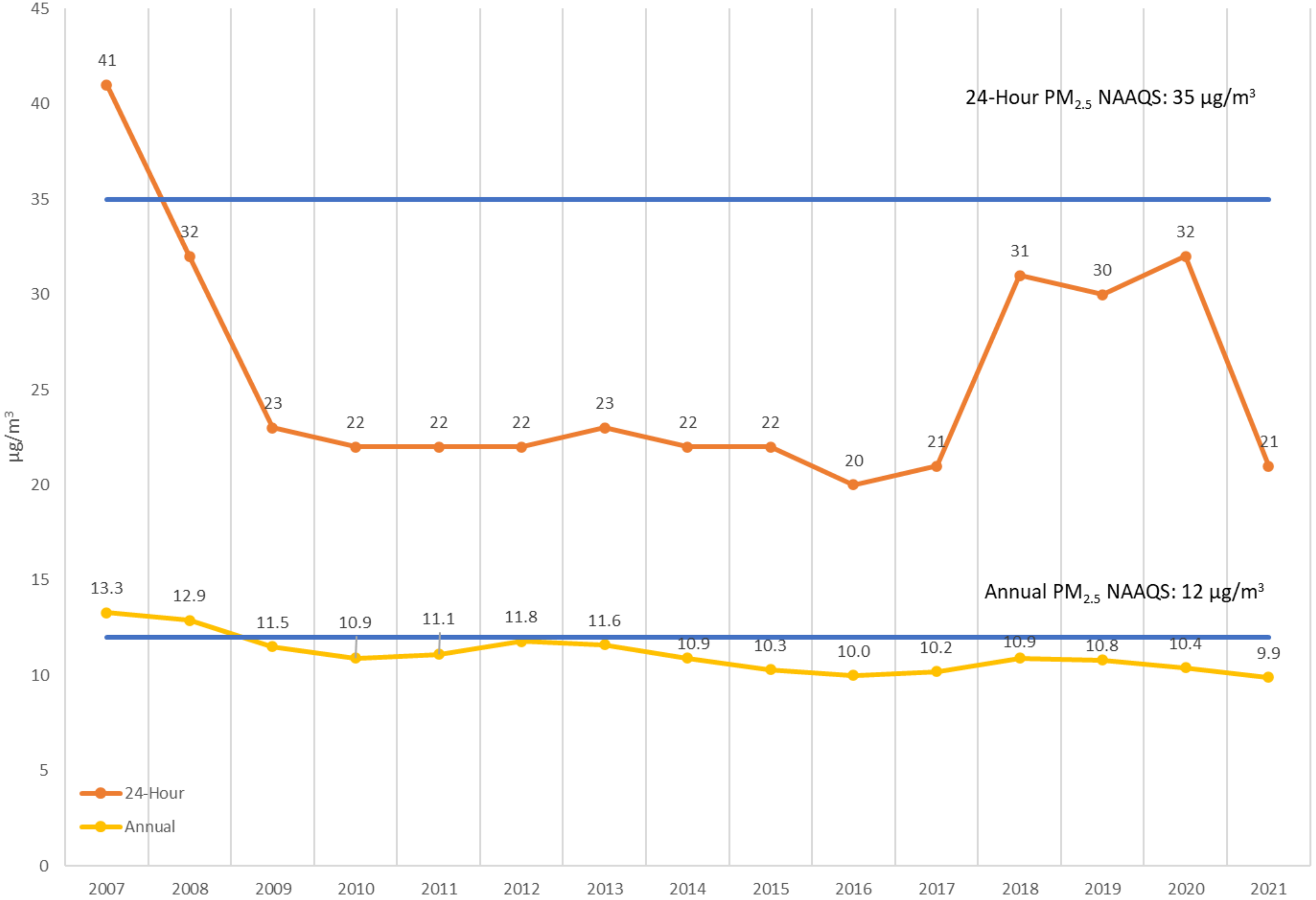


Oklahoma $PM_{2.5}$ Design Values
24-Hour $PM_{2.5}$ NAAQS: 35 μg/m³
Annual $PM_{2.5}$ NAAQS: 12 μg/m³
μg/m³
0
5
10
15
20
25
30
35
40
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
27
24
24
22
23
22
22
21
20
21
20
24
24
26
28
11.6
11.3
11.4
10.9
10.8
10.5
10.1
9.3
8.8
8.7
8.8
9.6
9.5
9.3
11.4
24-Hour
Annual



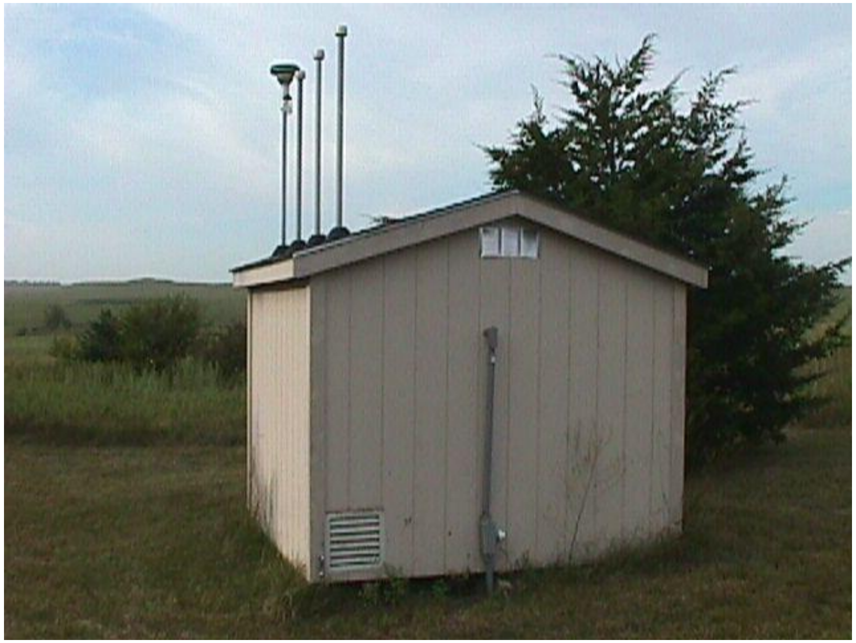
https://www.tceq.texas.gov/airquality/airsuccess/airsuccesscriteria

Louisiana $PM_{2.5}$ Design Values



IMPROVE/Regional Haze

- Measure current visibility and aerosol conditions in Class I areas
- Identify chemical species and emission sources responsible for anthropogenic visibility impairment
- Document long-term visibility trends
- Data integrated using reconstruction equation



Carbon Monoxide

- Carbon Monoxide NAAQS
  - 9 ppm 8-hour Average
  - 35 ppm 1 - hour Average
- Monitored by using Co's strong tendency to absorb IR radiation
- Sampling Method (non-dispersive infrared radiation, NDIR)
- Reference Method
- Analyzers
  - Non dispersive infrared
  - Gas filter correlation
  - Analytical wavelength 4.7 μm

Carbonyl Sampler

Automated Gas Chromatograph

The automated gas chromatograph continuously measures the concentration of VOCs in hourly samples. A thermal desorber cools, dries, and preconcentrates VOCs in the ambient air on a sorbent material. The sample is then heated rapidly and injected into the gas chromatograph where the VOCs are separated. (Location: Houston Deer Park #2)

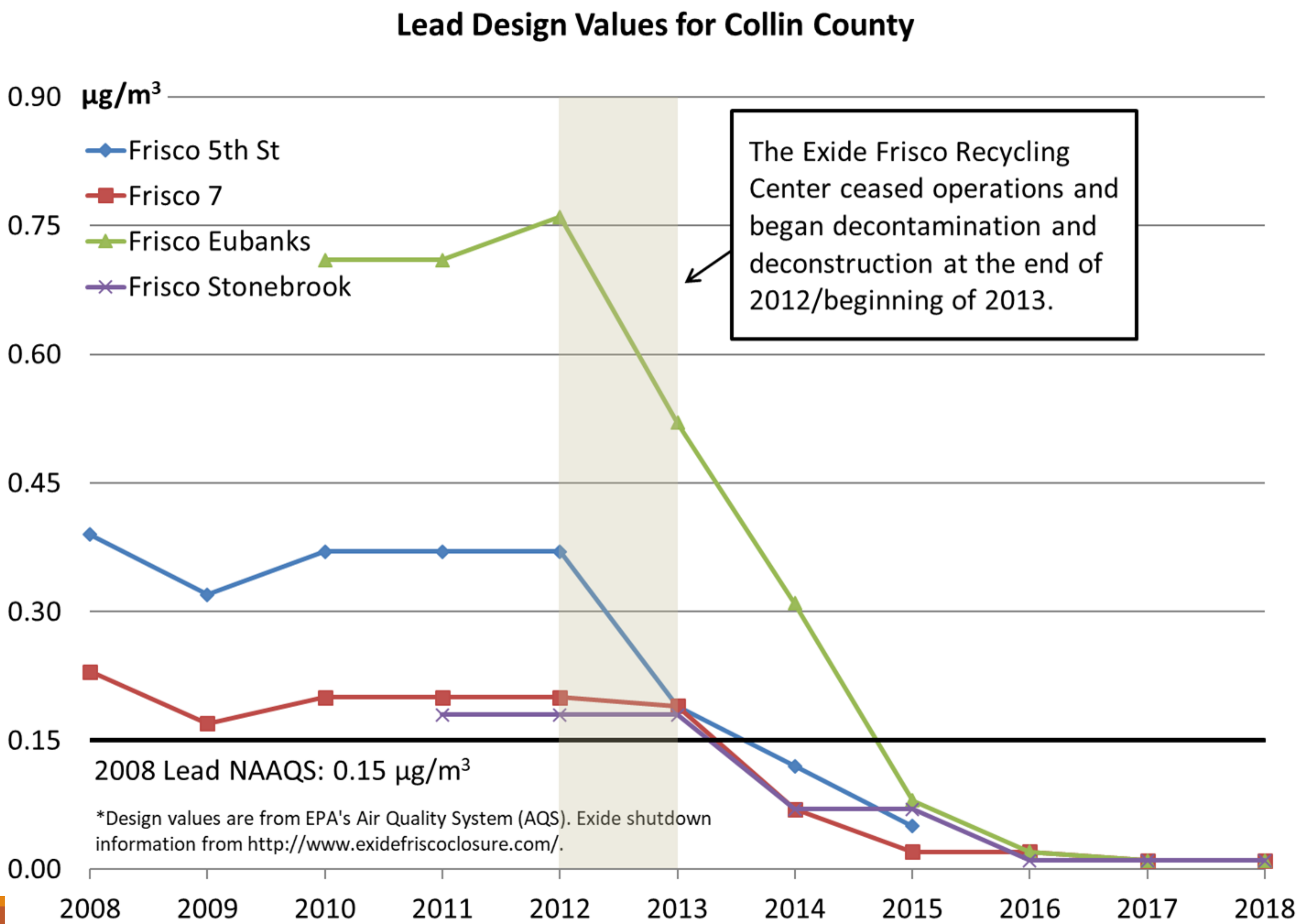
Solar and UV Radiation Sensors

The solar and ultraviolet radiation sensors measure the electromagnetic energy and ultraviolet radiation from the sun. (Location: El Paso Chamizal)

Lead

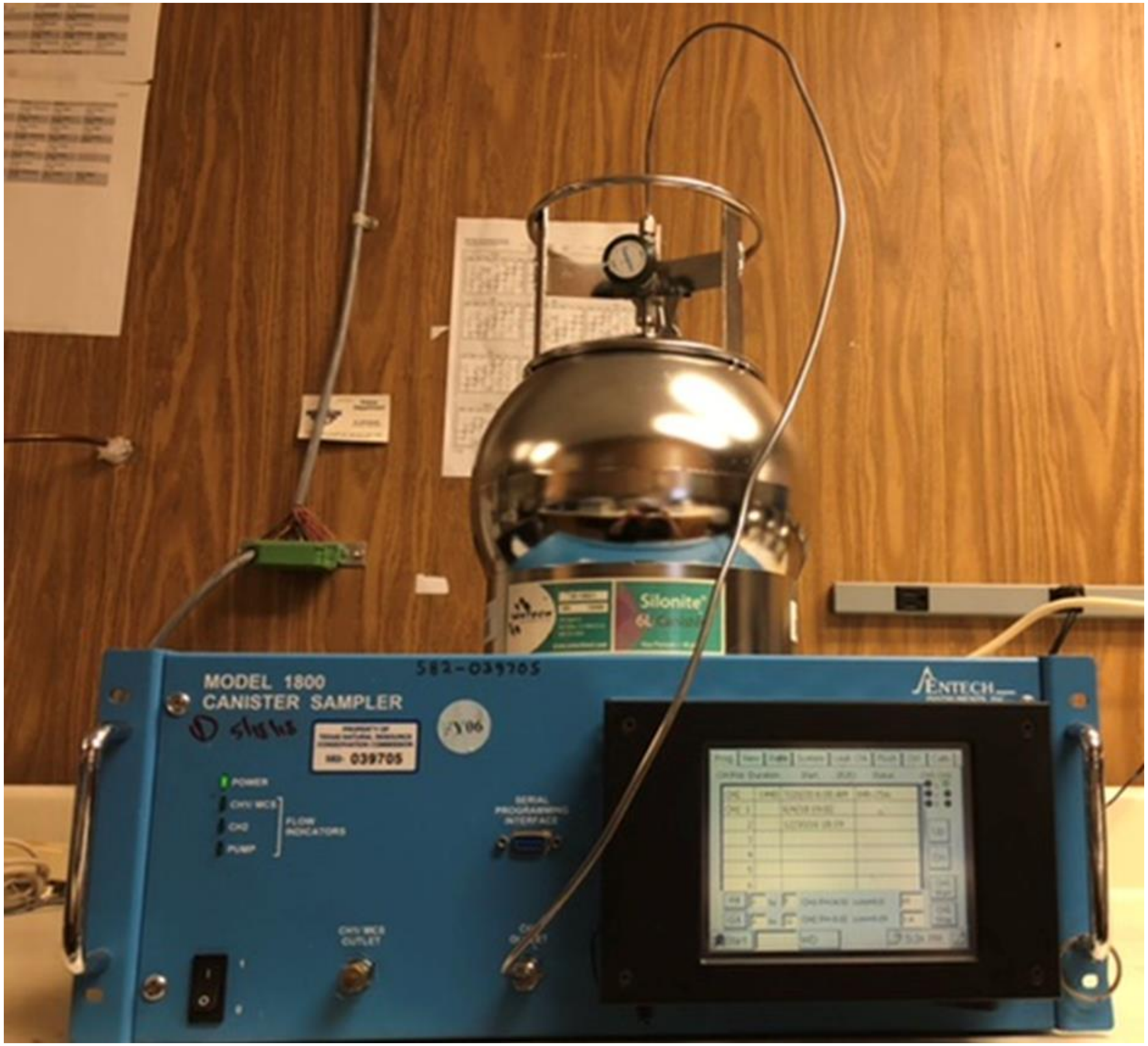
- Lead NAAQS
  - 0.15 $\mu g/m^3$ rolling 3-month average
- Sources
  - Primary and secondary lead smelters, mining, battery manufacturing, leaded aviation fuel, ammunition mfg.
- Monitored by TSP hi-vol monitor or other equivalent filter-based methods

Frisco Stonebrook Lead Monitor



https://www.tceq.texas.gov/airquality/airsuccess/airsuccesscriteria

Summa Canister & Sampler



Reserve Kansas Mercury - IMPROVE Monitoring Site

Meteorological Monitoring

Useful for

- Evaluating exceptional events
- Transport of pollutants
- Modeling

EPA QA Handbook Volume IV

Meteorological Equipment

- Wind direction
- Wind speed
- Temperature
- Relative humidity
- Rain fall
- Atmospheric pressure

Meteorological Tower

The meteorological sensors at the top of a 10-meter tower measure temperature, wind speed and direction, and relative humidity.
(Location – Houston Deer Park #2)

Calibration Equipment

- Often used for adjusting bias-type errors
- Measured values are compared to standard reference values or standard airflow measuring techniques/devices
- Airflow standard traceable to National Institute of Standards and Technology (NIST)
- Gas standards: traceable to a NIST reference material
  - CO, SO_2, NO_2, NO: available in cylinder gas or permeation tubes
  - NIST certified O_3 generator for ozone
- Equipment
  - Dilution Calibration Systems
  - Pure Air Generator
  - Certified Cylinder Gases

Quality Assurance Program

- Goal: Valid and reliable air quality monitoring data
- Quality Assurance (QA)
  - Setting policy and overseeing management controls
  - Planning, review of data collection activities and data use
  - Setting data quality objectives, assigning responsibilities, conducting reviews, and implementing corrective actions
  - Quality Assurance Project Plans developed for special studies
- Quality Control (QC)
  - Technical aspects of data quality programs
  - Implementation of specific QC procedures: calibrations, checks, replicate samples, routine self-assessment, and audits

Accuracy and Precision

Accuracy is how close a measured value is to the actual (true) value.

Precision is how close the measured values are to each other.

High Accuracy
Low Precision

Low Accuracy
High Precision

High Accuracy
High Precision

If you are playing soccer and you always hit the right goal post instead of scoring, then you are not accurate, but you are precise!

mathisfun.com

Bias

- When we measure something several times and all values are close, they may all be wrong if there is a "Bias“
- Bias is a systematic (built-in) error which makes all measurements wrong by a certain amount.
- Examples
  - The scales read "1 kg" when there is nothing on them
  - You always measure your height wearing shoes with thick soles.
  - A stopwatch that takes half a second to stop when clicked

What Do We Do With the Data?

- Quality assure it
- Compare data against air quality standards
- Conduct trend analyses
- Analyze any air quality events
- Health effects studies
- State Implementation Plan development
- Facility permitting
- Post it to the ODEQ website
- Upload to EPA's Aerometric Information Retrieval System (AIRS) database

Exercise

Kansas - https://www.kdhe.ks.gov/ArchiveCenter/ViewFile/Item/209

LDEQ - https://deq.louisiana.gov/assets/Air_Data_Sets/LDEQ_2021_Annual_Monitoring_Network_Plan_with_Cover_Letter.pdf

TCEQ - https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/2022-amnp-portfolio.pdf

ADEQ - https://www.adeq.state.ar.us/air/pdfs/2022-2023-ambient-air-monitoring-network-annual-network-plan_final.pdf

IDNR - https://www.iowadnr.gov/Portals/idnr/uploads/air/insidednr/monitoring/5_year_network_assessment_2020.pdf

ODEQ

NDEQ - http://dee.ne.gov/Publica.nsf/PubsForm.xsp?documentId=CBE6439A4B428E5C8625856D004DFD4D&action=openDocument

Emission Inventory

Emissions Inventory

- Compilation of pollutant emissions
  - Point: large stationary sources
  - Nonpoint: smaller non-permitted stationary sources
  - Mobile sources: on-road and non-road
  - Biogenic: natural sources
  - Event: fires and natural disasters
- Defined Geographic Boundary
  - Examples: state, county, city, census tract, etc.
  - Defined time period
  - Annual, seasonal, daily, hourly, etc.

Why Do We Need Emission Inventories?

- As a baseline for future planning
- For use in air quality modeling and risk assessments
- Tracking emissions trends/progress
- Determining compliance with regulations
- To help site ambient air monitors
- Projecting control strategy impacts
- Determining fee payments
- Public interest in clear air

Methods Used to Collect Source Data

- Surveys and questionnaires
- Permit applications or compliance files
- TRI and MACT databases
- State and local industrial directories
- State Departments of Commerce and Labor
- National and state directories of manufacturers
- Data compiled by private research and development companies, e.g. SRI
- Trade and professional associations

State Emission Data Collection Tools

- Annual surveys
- Online tool for collecting point source emissions from regulated facilities
  - Collect location data, contact information, stacks, SCC’s, process rates, emission factors, pollutant codes and emissions

Point Sources

- Large individual sources with permits
  - Refineries
  - Chemical plants
  - Electric generating units (EGUs)
  - Cement kilns
  - Natural gas compressor stations
  - Landfills
  - Metal fabrication
- Submit annual emission inventory forms
- Emissions data tend to be most accurate

Developing A Point Source Inventory

- Planning
- Form development
- Web tool adjustments
- Data gathering
- QA/QC
- Compiling the database
- Submittal to NEI

Data Elements in the Inventory

- Source Identification
  - Facility name and ID
- Source Location
  - Latitude, longitude
  - Physical address
  - State/County/Tribe
- Source Description
  - Release type – stack or fugitive
  - Stack parameters, capacity
  - Source type – Major or Area

Data Elements in the Inventory

- Process Description
  - North American Industry Classification System Code (NAICS)
  - Standard Industrial Classification Code – optional, replaced with NAICS
  - Source Classification Code (SCC)
  - MACT Code
  - Activity
  - Operating schedule
  - Throughput
  - Temporal data

Data Elements in the Inventory

- Control Device
  - Equipment type
  - Efficiency
- Emissions By Pollutant Species (CAS number)
  - Amount
  - Emission type – Entire period, average weekday, etc.
  - Estimation calculation methods
    - Include emission factor if this method is used
  - HAP emissions performance level – actual, allowable

Level of Detail for Point Source Data

- Source, Process, Control Device, Release Point, Pollutant, Emissions Type, Quantity

Annual Surveys

- Can be used to either:
  - Collect all information including emissions estimates and necessary data fields
  - Collect activity data and information about facility and its operations
- If emissions are not included as part of survey, agency develops emission estimates
  - EPA documents/tools
  - AP-42
  - Source test data

QA/QC

- Technical reviews
- Peer review
- Accuracy checks
- Reality checks
- Completeness checks
- Best implemented with standardized checklists, EIS Gateway submittal process

Non-point (Area) Sources

- Smaller than point sources
- Often grouped by sector
  - Dry cleaners
  - CAFOs
  - Household related emissions
  - Solvent cleaning
- Data is calculated using surrogate information
- Data not as accurate as point sources
- Some overlap with point sources
- Area-source MACTs blur regulatory status

How are Nonpoint Sources Typically Categorized?

- Fuel combustion
- Chemical and allied products manufacturing
- Metal processing
- Petroleum and related industries
- Other industrial processes
- Solvent utilization
- Storage and transport
- Waste disposal and transport
- Material storage/distribution
- Cooling towers
- Fires – prescribed burning, forest fires, structural fires, ag burning
- Hospital sterilizers
- Gasoline service stations
- Dry cleaners

Non-point Estimation Methods

- Surveys and questionnaires
- Material balance
- Emission factor x activity factors
- Emission models
- EPA Excel calculators and tools
  - Oil and gas
  - Residential wood combustion
- Careful not to double count point source emissions
- Detail needed:
  - County level
  - SCCs, NAICS codes

Sources of Activity Data

- US Dept. of Commerce
  - County Business Patterns
  - Census of Population
  - Census of Manufacturers
  - Census of Agriculture
  - County and City Data Book
  - Current Industrial Reports
  - Census of Retail Trade
- State Departments of Labor
- State Agriculture Offices and USDA
- State solid waste management agencies
- Fire marshals
- Port Authority
- Miscellaneous statistical government & trade publications

NEI Data for Your State

NEI Website: https://gispub.epa.gov/neireport/2014/

Trend:

https://edap.epa.gov/public/extensions/nei_report_2014/dashboard.html#trend-db

Point Source:

https://edap.epa.gov/public/extensions/nei_report_2014/dashboard.html#point-db

Process:
https://edap.epa.gov/public/extensions/nei_report_2014/dashboard.html#process-db

Mobile Sources

- On-road: cars, trucks, buses, etc.
  - Fuels: Gasoline, diesel, propane, LNG
- Non-road: rail, aircraft, marine vessels, agriculture, construction, etc.
- Evaporative, crankcase and tailpipe emissions
- EPA computer model generated data
  - Based on assumptions regarding make up of fleet and Vehicle Miles Traveled (VMT)
  - MOVES model
- Data quality varies with source category

On-road Mobile Category

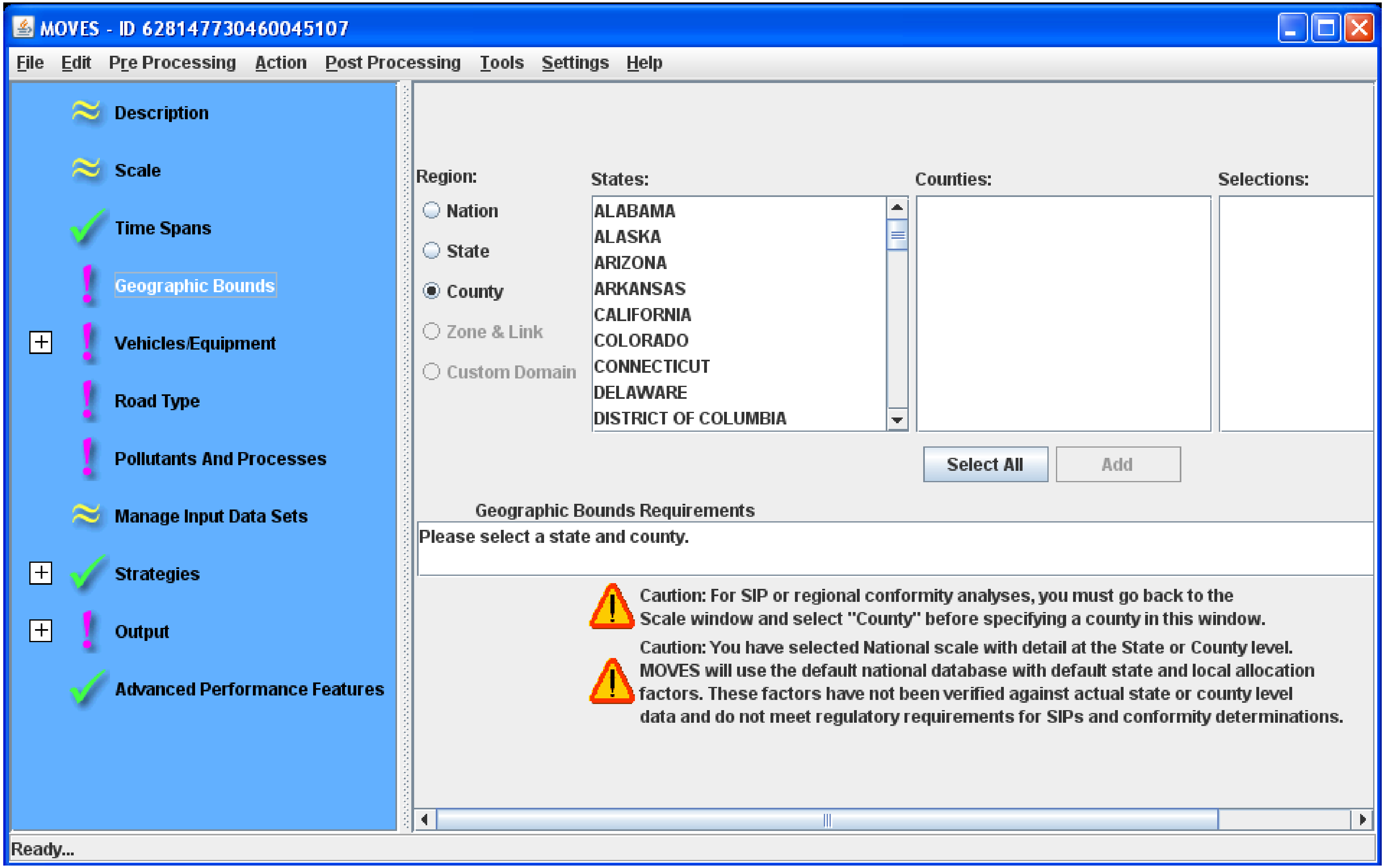
- Nationally, onroad mobile emissions account for:
  - 33.3% of total CO
  - 37.6% of total NO_x
  - 4.2% of total VOC
  - 7.3% of total HAP
- Emissions estimates generally based on:
  - Vehicle type (gross weight, fuel type)
  - Vehicle miles traveled (VMT) incl. day of week and time of day
  - Population of registered vehicles
  - Road classification (e.g., paved, unpaved, freeway, arterial)

Source: 2011 National Emissions Inventory version 1

EPA's Motor Vehicle Emission Simulator (MOVES) Model

- Stand-alone model - no separate user data needed for emissions
- Comprehensive - now on-road only, first used in 2008 NEI
- Emissions output scalable from national to local intersection
- Database-centered design - users run MySQL queries for producing customized outputs
- Ability to customize means complex operation - user needs to set up multiple lookup tables before running

MOVES “Master” Interface



Non-Road Mobile Category

- Nationally, nonroad mobile emissions account for:
  - 17.7% of total CO
  - 10.8% of total NO_x
  - 3.6% of total VOC
  - 5.2% of total HAP
- Emissions estimates generally based on:
  - Equipment type
  - Engine type (CI, SI 2-stroke, SI 4-stroke)
  - Fuel type (Gasoline, diesel, LPG, CNG)

Source: 2011 National Emissions Inventory version 1

EPA’s Non-Road Model

- Stand-alone model - no separate user data needed for non-road mobile emissions
- Emissions output at county level
- Emissions for all non-road sources except aircraft, commercial marine, and locomotives
- Basic emissions algorithms based on emission factors, avg. rated power, avg. load factor, deterioration factor, and equipment population
- Model used through 2011 NEI, scheduled to be incorporated into MOVES for 2014 NEI

Biogenic & Geogenic Sources

- Trees/Plants
  - VOCs
  - Terpenes
- Volcanoes
  - PM
  - SO2

Flint Hills, Riley County, KS

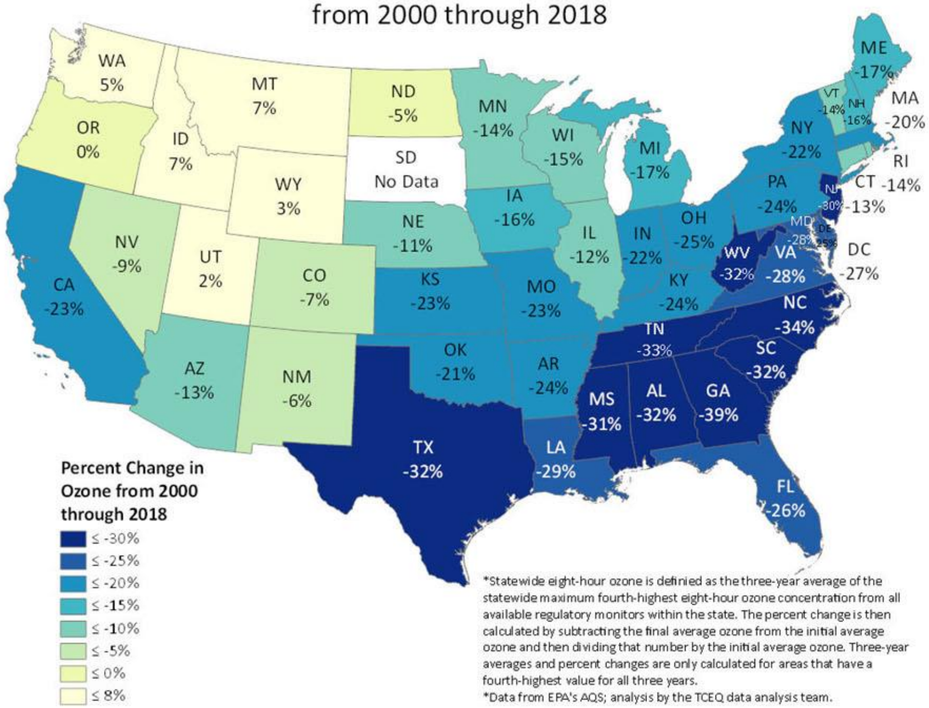
National Emissions Inventory (NEI)

- Published every 3 years –2011, 2014, 2017
- Air Emissions Reporting Rule (AERR) final in 2008
  - Type A point source – every year
  - Other point, nonpoint and mobile every 3 years
  - Time frame – state data due Jan. 1 of the following year
- https://gispub.epa.gov/neireport/2017/

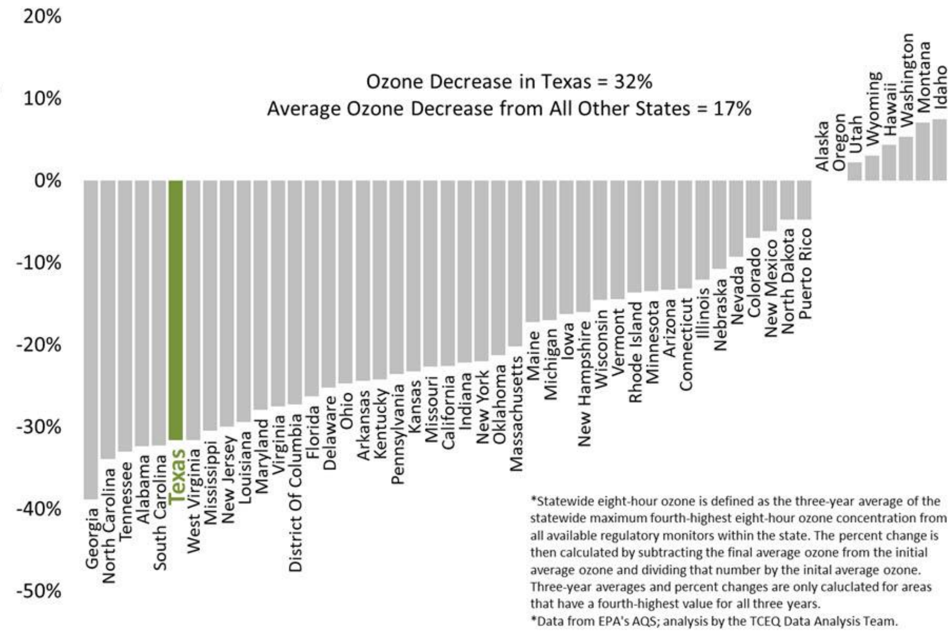
NEI Submittal Process

- Export data from state/local database
- Compile in MS Access using EIS Staging Tables
- Use EIS Bridge Tool to create XML formatted file
- Submit zipped XML file to EPA Node Client
- Check feedback reports on EIS Gateway
- Repeat steps 2-5 … like shampooing

Percent Change in Maximum Fourth-Highest Eight-Hour Ozone from 2000 through 2018



Percent Change in Statewide Eight-Hour Ozone from 2000 through 2018



CAERS

The Combined Air Emissions Reporting (CAER) project seeks to streamline the way industry reports air emissions to meet EPA, state, local, and tribal program requirements. The CAER System (CAERS) is an electronic reporting application that allows facilities to report to more than one program via a single data submission.

https://e-enterprisefortheenvironment.net/our-projects/combined-air-emissions-reporting-caer/

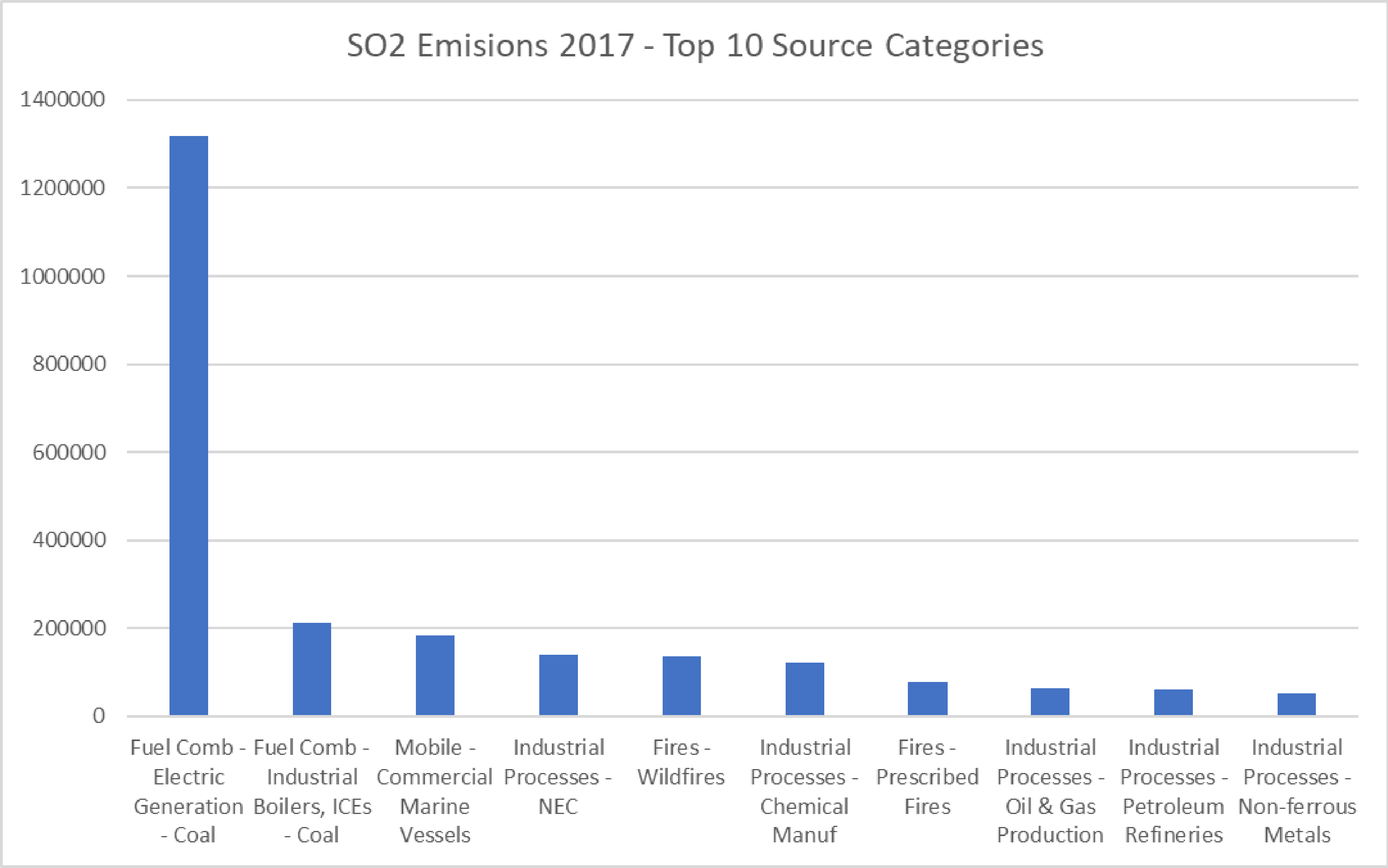
Data to Review

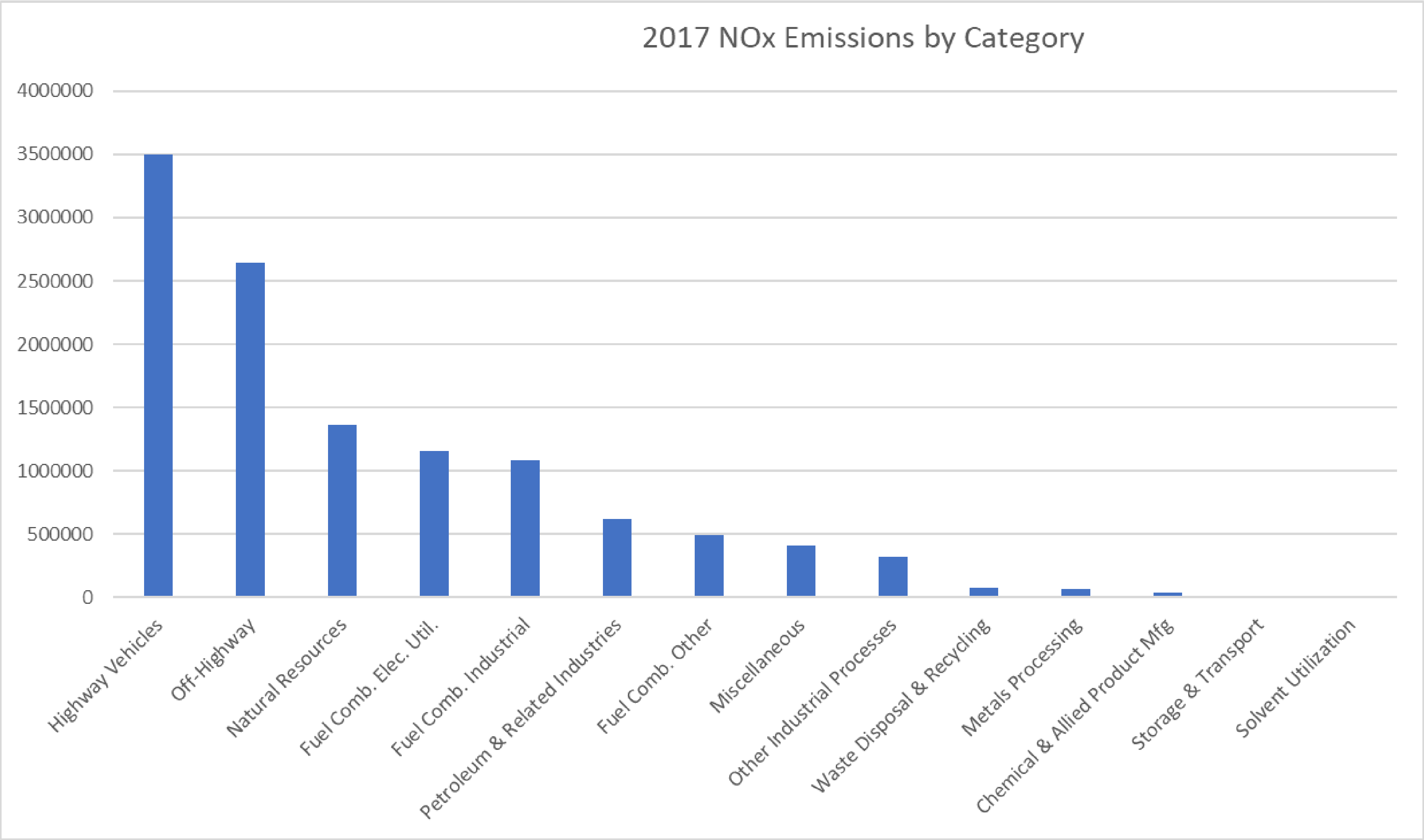
NEI Point Source

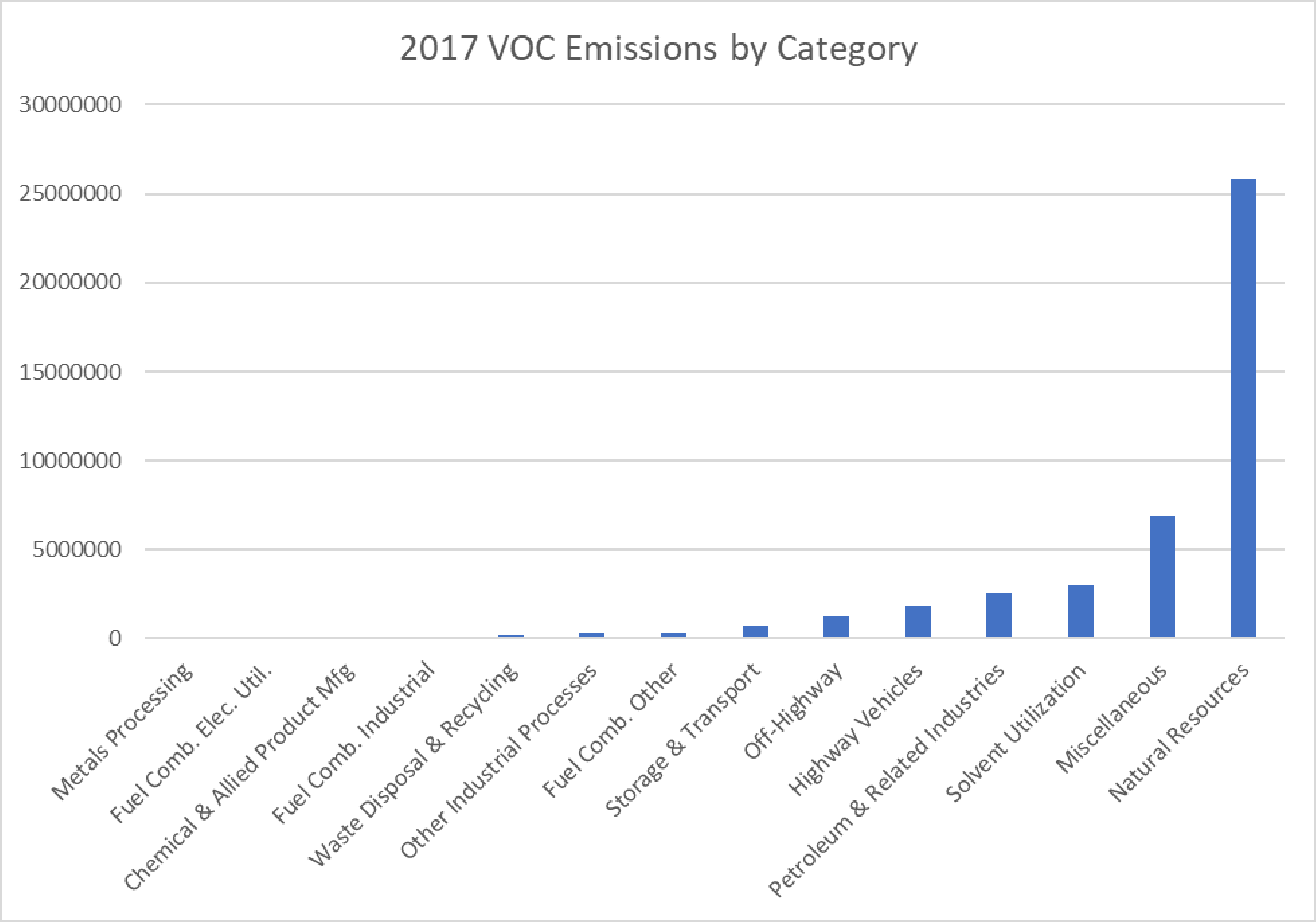
https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data#dataq

State Trend Data

https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data


SO2 Emisions 2017 - Top 10 Source Categories
1400000
1200000
1000000
800000
600000
400000
200000
0
Fuel Comb - Electric Generation - Coal
Fuel Comb - Industrial Boilers, ICEs - Coal
Mobile - Commercial Marine Vessels
Industrial Processes - NEC
Fires - Wildfires
Industrial Processes - Chemical Manuf
Fires - Prescribed Fires
Industrial Processes - Oil & Gas Production
Industrial Processes - Petroleum Refineries
Industrial Processes - Non-ferrous Metals


2017 NOx Emissions by Category
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
Highway Vehicles
Off-Highway
Natural Resources
Fuel Comb. Elec. Util.
Fuel Comb. Industrial
Petroleum & Related Industries
Fuel Comb. Other
Miscellaneous
Other Industrial Processes
Waste Disposal & Recycling
Metals Processing
Chemical & Allied Product Mfg
Storage & Transport
Solvent Utilization


2017 VOC Emissions by Category
30000000
25000000
20000000
15000000
10000000
5000000
0
Metals Processing
Fuel Comb. Elec. Util.
Chemical & Allied Product Mfg
Fuel Comb. Industrial
Waste Disposal & Recycling
Other Industrial Processes
Fuel Comb. Other
Storage & Transport
Off-Highway
Highway Vehicles
Petroleum & Related Industries
Solvent Utilization
Miscellaneous
Natural Resources

Class Poll:

What emissions inventory data is the most accurate? Second most accurate?

A. Engines that have been tested in a factory
B. Range fire emissions calculated using satellite imagery
C. Sources with monitors in the stacks
D. Emissions from volcanoes in the Pacific Northwest
E. Evaporative emissions of VOCs from tank farms
F. A well-informed guess

LDEQ Data Sources

Facility and Permit Database:
TEMPO

Emissions Inventory & :

U.S. Air Quality:
https://www.epa.gov/outdoor-air-quality-data

Air Quality Forecasts / AQI / Monitoring Data:
https://airquality.deq.louisiana.gov/

https://www.deq.louisiana.gov/page/ambient-air-monitoring-program

TCEQ Data Sources

Facility and Permit Database:
https://www.tceq.texas.gov/permitting/permit_data.html

Complaints and Inspection Database:
https://www.tceq.texas.gov/compliance/complaints/track.html

Monitor Database:
https://www.tceq.texas.gov/airquality/monops

Air Quality Forecasts:
https://www.tceq.texas.gov/airquality/monops/forecast_today.html

ODEQ Data Sources

Facility and Permit Database:
http://www.adeq.state.ar. ADEQ Data Sourcesus/home/pdssql/pds.aspx

Complaints and Inspection Database:
http://www.adeq.state.ar.us/complaints/searches/

Monitor Database:
https://www.epa.gov/outdoor-air-quality-data

Air Quality Forecasts:
http://www.adeq.state.ar.us/

http://www.adeq.state.ar.us/techsvs/air_chem_lab/dailyaqidata_littlerock.aspx

http://www.adeq.state.ar.us/techsvs/air_chem_lab/dailyaqidata_springdale.aspx

Class Exercise:

Which of these is an example of point source emissions? Be prepared to explain what the other examples represent.

A. Military jets flying over your state enroute to their base
B. The local craft brewery's VOC emissions
C. Long-haul trains on the Union Pacific / KC Southern tracks
D. Arrivals and departures at DFW airport.
E. The electric generating facility supplying power to your home
F. Tailgating fans on the (pick your favorite) LSU / UT/ OSU/ KSU / UI / UN-L / U of A Campus
G. Switching of engines and trains at the KCS switchyard
H. Driving my food truck to the local downtown area to serve meals

New Source Performance Standards

New Source Performance Standards (NSPS)

- Sec. 111 of the CAA directs EPA to develop “standards of performance for new stationary sources”
- Intended to promote use of **proven** emissions reduction technologies
- Standards of performance shall:
  - “. . . reflect the degree of emission limitation and the **percentage reduction achievable** through application of the best technological system of continuous emission reduction which (**taking into consideration the cost** of achieving such emission reduction, any non air quality health and environmental impact and energy requirements) the Administrator determines has been **adequately demonstrated.**

NSPS

- NSPS are federal regulations found at 40 CFR Part 60
  - https://www.epa.gov/stationary-sources-air-pollution/new-source-performance-standards
- States most often adopt the federal NSPS
- EPA delegates authority to the state to enforce
  - AR Reg. 19.304

NSPS Applicability

- NSPS are developed by source categories and apply to:
  - New sources
    - Date specified in NSPS
    - Usually the date of **proposal**
  - Modified sources
    - 40 CFR 60.14 provides that an existing facility is modified, and therefore subject to an NSPS, if it undergoes "any physical change in the method of operation . . . which increases the amount of any air pollutant emitted by such source or which results in the emission of any air pollutant not previously emitted."
  - Reconstructed sources
    - 40 CFR 60.15, in turn, provides that a facility is reconstructed if components are replaced at an existing facility to such an extent that the capital cost of the new equipment/components exceed 50 percent of what is believed to be the cost of a completely new facility.

NSPS Pollutants

- NSPS primarily regulate Criteria Pollutants
  - Some exceptions:
    - Dioxin/furans
    - Fluorides
    - Hydrogen Chloride
    - Hydrogen Sulfide
    - Sulfuric Acid Mist
    - Total Reduced Sulfur
    - Total Suspended Particulate (TSP)
- NSPS specify an emissions rate, not a specific control technology

How NSPS are Established

Identify the type of emitting facility (boiler, landfill, refinery, gas turbine, etc).

For each type of facility, identify the type of pollutant control technology that is appropriate.

- Can consider costs of control
- Emissions impacts of various options are also considered

From a study of all the facilities and all the information available about the facilities and their technologies, establish an allowed concentration of the criteria pollutants that is the upper limit of what can be emitted.

NSPS

- Federal oversight authority: Enforce their NSPS regulations
- Emission Guidelines….an NSPS' second cousin for existing facilities (111(d))
  - EPA can develop emission guidelines for certain existing source categories for which an NSPS has been promulgated
  - EPA promulgates rule with framework for state regulations
  - States develop regulations to implement the emissions guidelines as part of their program
  - Provides more flexibility to states
  - Waste combustors and landfills are two examples
  - Greenhouse Gas Emissions from EGUs was one of last to be published on 8/31/18
    - https://www.federalregister.gov/documents/2018/08/31/2018-18755/emission-guidelines-for-greenhouse-gas-emissions-from-existing-electric-utility-generating-units

National Emission Standards for Hazardous Air Pollutants

NESHAPs

- Significantly modified by the CAAA 1990
- Prior to 1990, NESHAPs were health based standards
  - Did not work
- 40 CFR Part 61
  - 8 substances designated as hazardous air pollutants in 20 years (as stated at 40 CFR 61.01)
    - **Asbestos** (36 FR 5931; Mar. 31, 1971)
    - **Benzene** (42 FR 29332; June 8, 1977)
    - Beryllium (36 FR 5931; Mar. 31, 1971)
    - Coke Oven Emissions (49 FR 36560; Sept. 18, 1984)
    - Inorganic Arsenic (45 FR 37886; June 5, 1980)
    - Mercury (36 FR 5931; Mar. 31, 1971)
    - Radionuclides (44 FR 76738; Dec. 27, 1979)
    - Vinyl Chloride (40 FR 59532; Dec. 24, 1975)

NESHAPs

- CAA sec. 112(b)(2)
  - Pollutants that “present….through inhalation or other routes of exposure, a threat of adverse human health effects….
  - substances which are known ….or may ….be, carcinogenic, mutagenic, teratogenic, neurotoxic, which cause reproductive dysfunction, or which are acutely or chronically toxic….
  - Or adverse environmental effects whether through ambient concentrations, bioaccumulation, deposition, or otherwise . . . .”

NESHAPs Changes

- Congress significantly amended section 112 of the CAA in 1990
  - Due to logjam in original process…4,600 years to go at the rate of progress at the time
  - Listed 189 Hazardous Air Pollutants (HAPs)
    - List has been reduced to 187 substances
    - Most are VOCs , metals and chlorinated compounds
  - EPA developed a list of source categories that emitted HAPs
  - EPA required to develop technology based standards for listed source categories…. MACTS were born

More Changes

- EPA to develop Maximum Achievable Control Technology (MACT) standards for major emitters over 10 years
  - Best controls for new sources
  - Average of top 12% for existing sources
- Generally Available Control Technology (GACT) (less stringent than MACT) allowed for area sources……..*we needed yet another ACTronym*
- Residual risk review - Follow-up studies are to be conducted to demonstrate the MACT is protective of public health

Still More Changes

- Major source and area source HAPs thresholds
  - Major source –
    - >= 10 TPY of a single HAP
    - >= 25 TPY of a combination of HAPs
  - Area source is a HAP source that is not a major source

- What is a new source and an existing source?
  - A new source – commences construction after the initial proposal of an applicable MACT standard
  - An existing source – any HAP source that is not a new source

MACT Hammer

- If EPA missed a deadline for promulgating a MACT standard, the “MACT hammer” kicked in
  - MACT hammer hammered the states and locals
  - In such cases, CAA section 112(j) requires states/locals to develop case-by-case MACT for new sources that exceeded the thresholds

- MACT standards found at 40 CFR Part 63
  - https://www.epa.gov/stationary-sources-air-pollution/national-emission-standards-hazardous-air-pollutants-neshap-9

MACT Implementation

- Most states have adopted MACT standards as EPA promulgates them….within a year or two
  - https://www.federalregister.gov/documents/2015/02/27/2015-04171/delegation-of-authority-to-the-states-of-iowa-kansas-missouri-nebraska-lincoln-lancaster-county-ne#t-3
- EPA delegates to states the authority to enforce the MACT standards
- States can develop more stringent standards instead
- Federal oversight authority to enforce their NESHAP regulations

MACT Implementation

- EPA has developed an "Integrated Urban Air Toxics Strategy" to meet various requirements of the 1990 CAA amendments (1999)
  - Looks at air toxic emissions from major, area and mobile sources
  - Combines several air toxic mandates
  - Utilizes regulatory, voluntary and educational means to reduce health risks associated with air toxics
  - EPA models health risks and publishes "risk maps"

- http://www.epa.gov/national-air-toxics-assessment

Small Business Assistance

- All states required to have under Title V, primarily due to the small sources that would be subject to MACT
- Within your agency, it is called: _______________

Regional Haze

Regional Haze

- The purpose of the Regional Haze program is to reduce visibility impairment due to man-made pollution in federal Class I areas
  - National Parks and Wildlife Areas
  - Neither Kansas nor Nebraska has a Class I Area
  - Missouri, Arkansas, Texas, Louisiana, & Oklahoma do
- In 1980, EPA promulgated a rule to improve our understanding of the causes of regional haze
  - States with Class I areas were required to submit periodic reports regarding activities that impacted Class I areas

http://www.epa.gov/visibility/class1.html

Mandatory Class I Areas

* Rainbow Lake, WI and Bradwell Bay, FL are Class 1 Areas
where visibility is not an important air quality related value

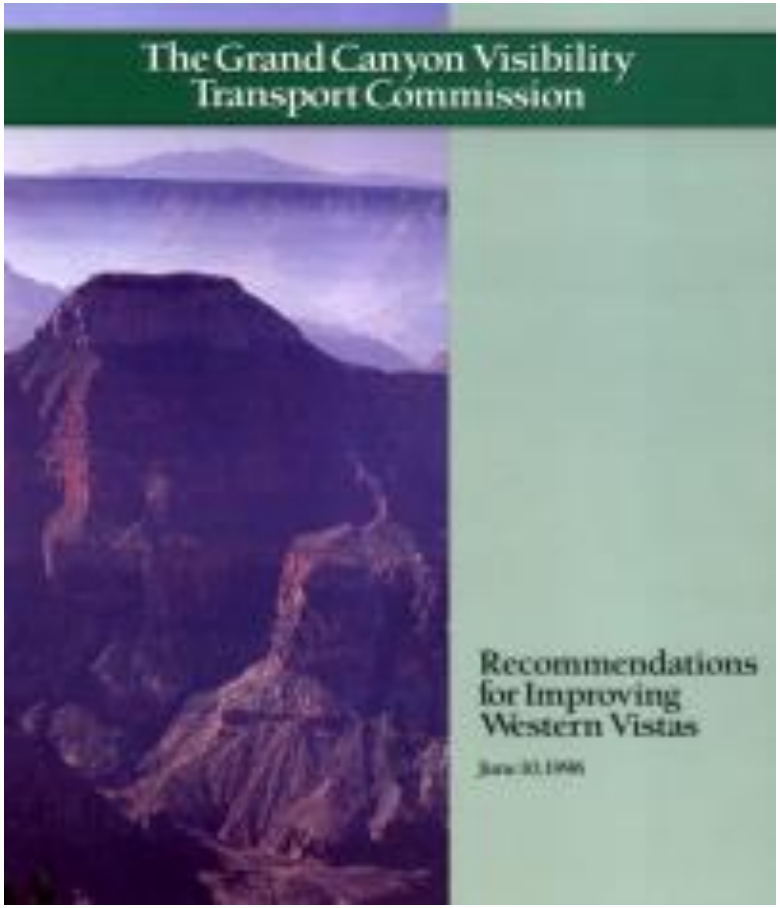
Produced by NPS Air Resources Division

Grand Canyon Visibility Transport Commission

EPA Administrator William Reilly used 1990 amendments

Grand Canyon Visibility Transport Commission had 4 years (til 1994)

Issued report to EPA on June 10, 1996



Regional Haze Revisions

- EPA promulgated Regional Haze rule in 1999 and revised it January 10, 2017
  - (40 CFR 51.300 – 51.309)
  - Aka Clean Air Visibility Rule
  - Listed 156 Class I areas
  - **All states** presumed to contribute to haze in Class I areas
  - Air Quality agencies were required to develop rules:
    - To improve visibility on the haziest days
    - To ensure no degradation on the clearest days
  - Goal is to reach natural background within 60 years
  - State plan reevaluated every 10 years
  - Best Available Retrofit Technology (BART) was required on certain existing sources
  - "Reasonable progress" goal required to be addressed

Regional Haze Revisions

- EPA promulgated Regional Haze rule in 1999 and revised it January 10, 2017
  - strengthening the federal land manager consultation requirements
  - extending the RAVI requirements so that all states must address situations where a single source or small number of sources is affecting visibility at a Federal Class I area
  - extending the SIP submittal deadline for the second planning period from July 31, 2018 to July 31, 2021 to allow states to consider planning for other federal programs like the 2010 one-hour SO2 NAAQS, and the 2012 annual PM2.5 NAAQS
  - adjusting interim progress report submission deadline so that second progress reports would be due by January 31, 2025; and
  - removing the requirement for progress reports to be SIP revisions so the EPA would not formally approve or disapprove them.

Regional Haze Revisions

- On January 17, 2018, the EPA announced its decision to revisit certain aspects of the 2017 Regional Haze Rule revisions.

- The EPA's draft guidance on the rule was released on June 30, 2016.
  - In January 2018, the EPA announced plans to finalize one or more EPA guidance documents for regional haze state implementation plan (SIP) revisions due in 2021.
  - In September 2018, EPA announced Regional Haze Reform Roadmap to reduce regulatory burdens.
  - States received Regional Haze SIP guidance in late 2019.
- https://www.epa.gov/visibility/visibility-guidance-documents

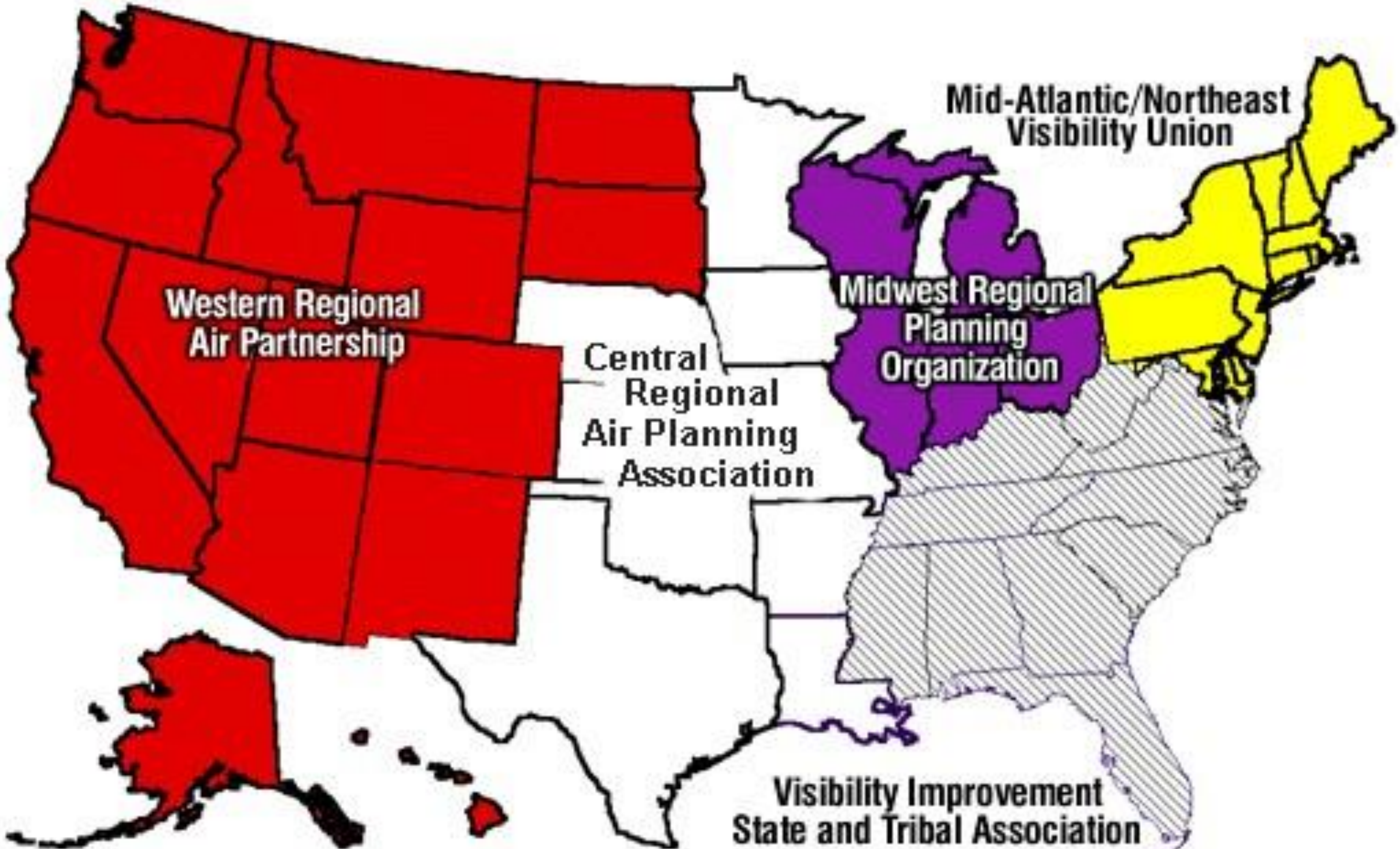
Coordination and Cooperation

40 CFR Section 51.307 requires the operator of any new major stationary source or major modification located within 100 kilometers of a Class I area to contact the Federal Land Managers for that area in order to provide information about the emissions from the source and any possible impact on visibility in the Class 1 area.

Regional Planning Organizations

- Five Regional Planning Organizations (RPOs) formed to conduct the technical evaluations on which Regional Haze SIPs and TIPs could be developed
- Encouraged cooperation between states, tribes, EPA, FLMs, regulated community, environmentalists, citizens
- CENRAP was the RPO for the CenSARA states and federally recognized tribes within the boundaries of the CenSARA states
  - CENRAP lapsed due to lack of funding
  - CenSARA currently conducting Regional Haze planning activities

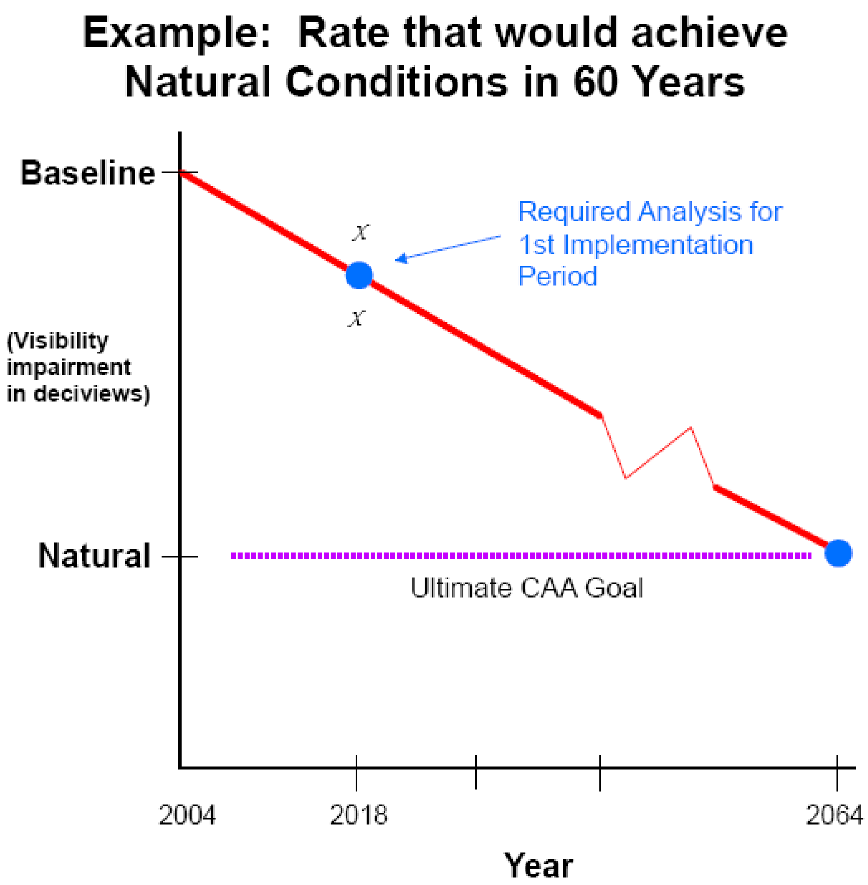
Regional Planning Organizations



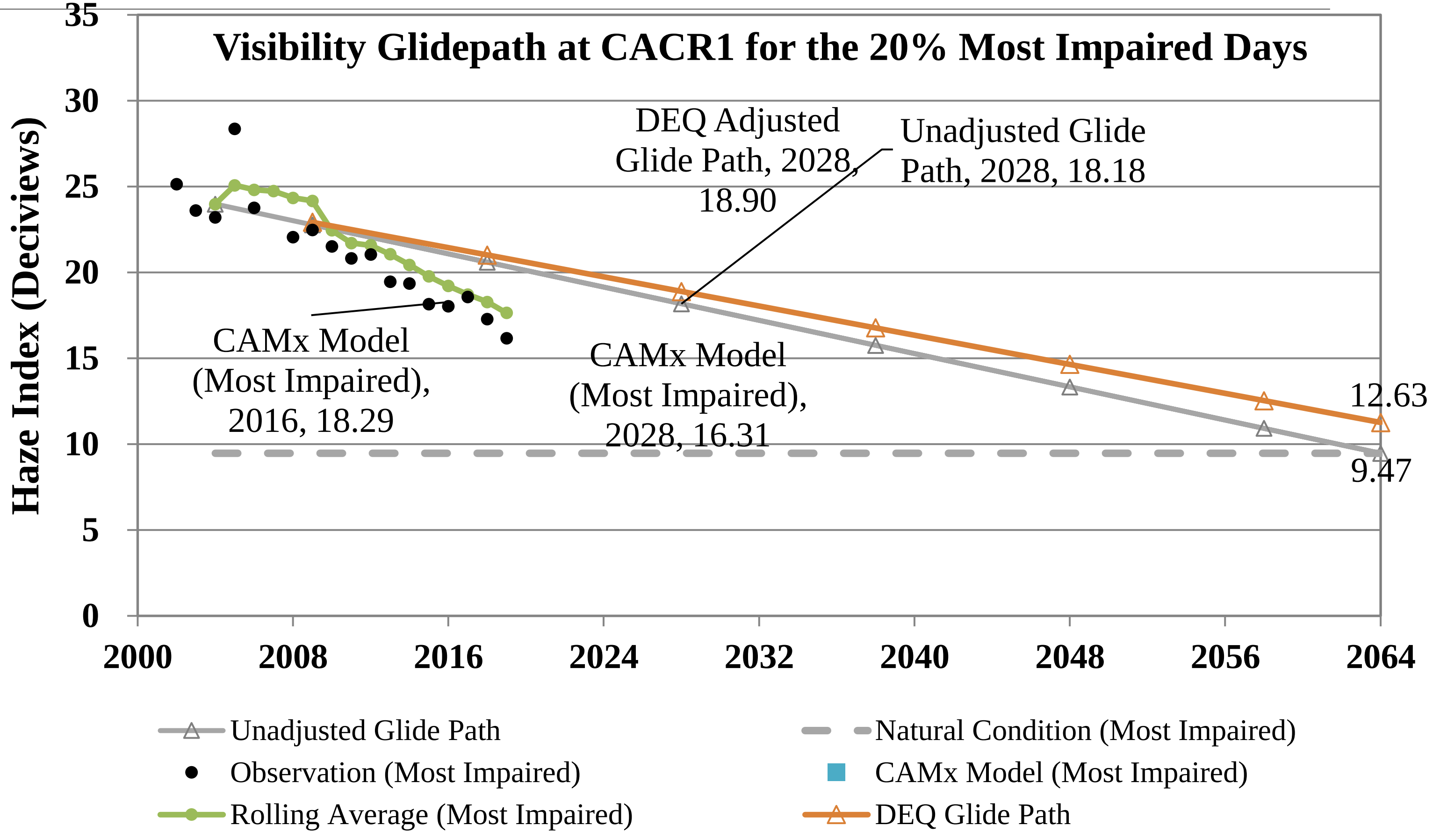
Regional Haze

- There are 10 Class I areas within CENRAP
- CENRAP conducted modeling to determine causes of, and contributions to haze in the 10 Class I areas
- The pollutants being evaluated primarily were:
  - Elemental carbon
  - Organic carbon
  - Ammonium Sulfate
  - Ammonium Nitrate
  - Crustal material
  - Sea salt

Example of Glidepath



Visibility


Visibility Glidepath at CACR1 for the 20% Most Impaired Days
Haze Index (Deciviews)
35
30
25
20
15
10
5
0
2000
2008
2016
2024
2032
2040
2048
2056
2064
DEQ Adjusted Glide Path, 2028, 18.90
Unadjusted Glide Path, 2028, 18.18
CAMx Model (Most Impaired), 2016, 18.29
CAMx Model (Most Impaired), 2028, 16.31
12.63
9.47
Unadjusted Glide Path
Observation (Most Impaired)
Rolling Average (Most Impaired)
Natural Condition (Most Impaired)
CAMx Model (Most Impaired)
DEQ Glide Path

Regional Haze Round 1

- The 9 states used the technical data generated by the RPOs to develop SIPs
- The states reviewed their sources to determine which were required to undertake a BART analysis
  - BART analysis involved CalPuff modeling
- The partial disapproval surrounded non-EGU facility BART units as well as EGU BART units trapped in the CAIR/CSAPR litigation.

Regional Haze Round 2

- CenSARA contracted with Ramboll to perform Area of Influence Analysis work
  - To assist states in identifying point sources that are large contributors to haze

Round 2 SIP Status

39 States failed to submit by July 31, 2021 deadline

Sierra Club and collection of environmental organizations filed NOI to sue on 2/7/2022 because EPA did not make required completeness determinations or issue Finding of Failure to Submit.

On April 7, U.S. EPA announced the Agency's intent to make findings that certain states have failed to submit regional haze implementation plans for the second planning period.

- The EPA intends to issue these findings by August 31, 2022.
- States wishing to avoid inclusion in the Findings of Failure to Submit should submit their second planning period SIPs by August 15, 2022.

KS, TX submitted on time, a few others might make the 8/15/22 deadline

Round 3 SIP Process

Round 3 SIPs are due to EPA by July 2028

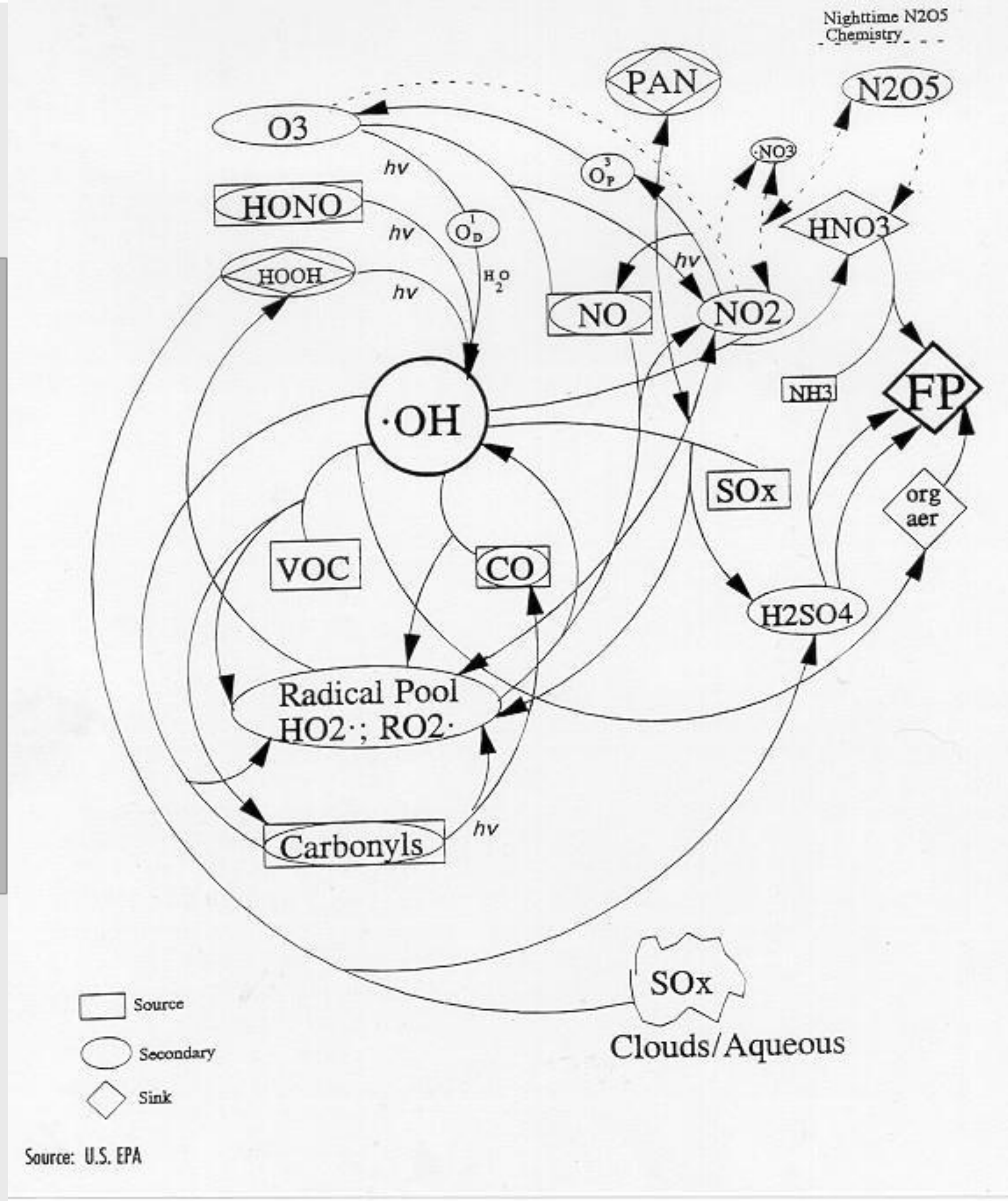
MJOs are beginning to meet to discuss:

- Planning year vs base year for RH
- Priorities for changes to RH rule and guidance
- Incorporating EJ into RH SIPs in 3rd planning period

Modeling

Pre-test:

If you understand this, you are wasting your time and should probably go back to work.



What We Will Cover

- Overview of AQ Models
- Uses of modeling
- Dispersion models
- Emissions models
- Meteorological models
- Photochemical models
- Other tools
- Exceptional event request

What is Modeling?

- Three different expert definitions….plus mine:
  - Mathematical simulation of atmospheric processes which gives a convenient and physically meaningful way of relating sources/emissions to ambient air impacts.
  - Mathematical formulations that include parameters that affect pollutant concentrations.
  - Mathematical simulation of emissions as they are transported throughout the atmosphere
  - A computerized way of figuring where stuff in the air (probably) goes

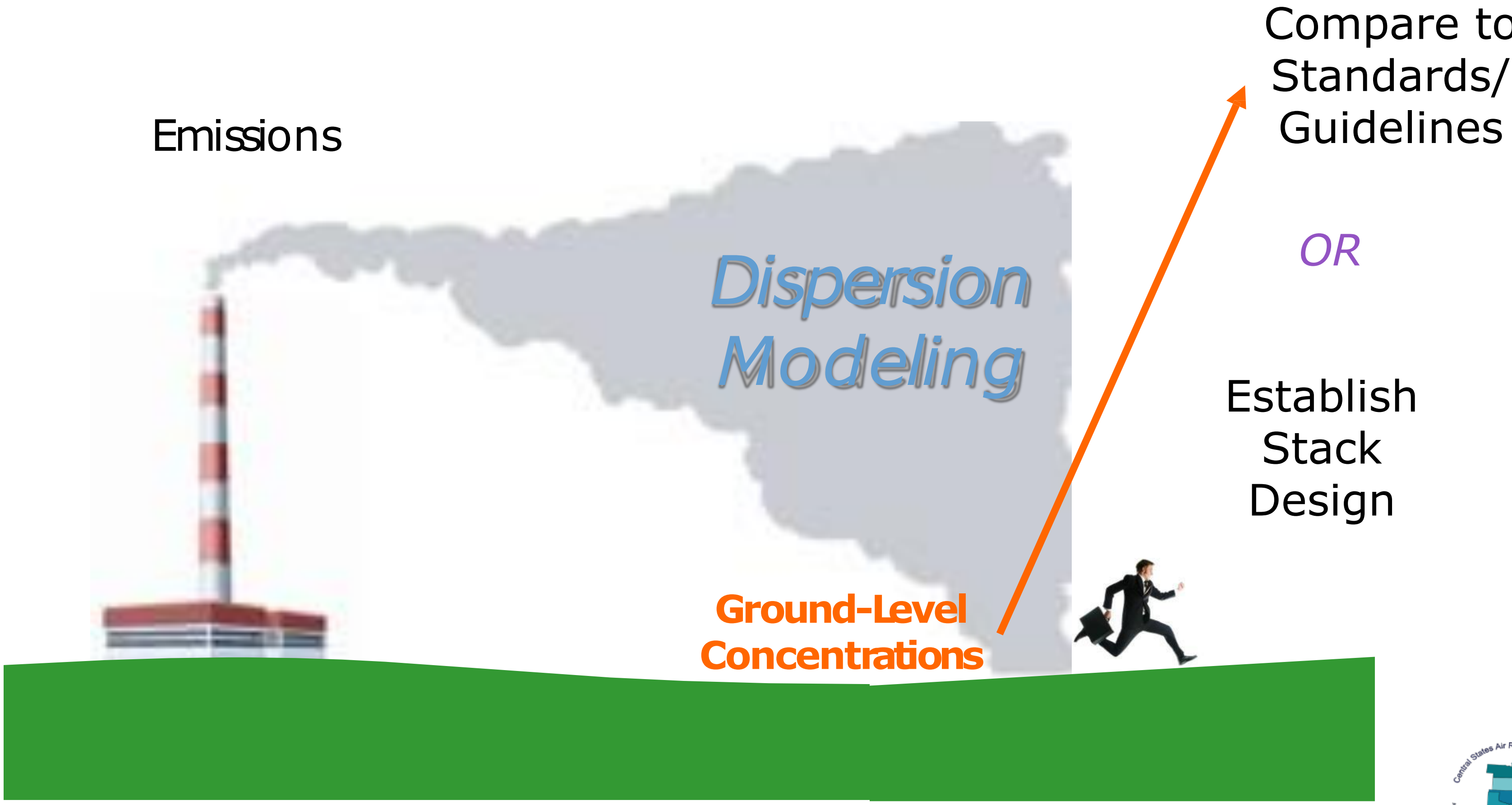
Many models – many purposes

- ISC3
- AERSCREEN
- AERMET
- AERMAP
- AERMOD
- CALMET
- CALPUFF
- MOVES
- MM5
- WRF
- CAMX
- CMAQ
- HYSPLIT

Dispersion Modeling Uses

- Assess air quality impacts for new/modified sources
  for construction permit review
- Demonstrate control strategies/equipment
- Identify appropriate locations for monitoring sites
- Fill in for monitoring data gaps – SO_2
- Evaluate compliance with NAAQS and increment
- Determine extent of emission reductions required for SIPs
- Forecast scenarios to determine future impacts for prescribed fires

Dispersion Modeling



Dispersion Modeling

- Assumes plume spreads primarily by molecular diffusion
- Plume spread and shape vary in response to meteorological conditions
- Steady-state source emissions conditions
- Typical grid cell size: 50 m near source, then up to 500 m more distant
- Not capable of treating photochemistry
- More reliable for long averaging periods at a specific location

Structure of a Dispersion Model

For Each Point Source

- Physical Height
- Coordinates
- Stack Dimensions
- Stack Gas Velocity
- Stack Gas Temperature
- Building Dimensions
- Pollutant Emission Rate

Meteorology

- Wind Speed / Direction
- Ambient Temperature
- Atmospheric Turbulence
- Mixing Height

For Each Receptor

- Coordinates
- Ground Level Elevation
- Height Above Ground

Simulation of Atmospheric Physics

Estimate of Air Pollutant Concentrations at Receptors

Permit Modeling Process

- It all starts with a phone call
- Pre-modeling meeting
- Develop modeling protocol
- Define modeling domain, receptors,
- Obtain and process terrain elevation data
- Obtain background air quality data
- Develop inventory of nearby sources
- Obtain and process representative meteorological data
- Input building data and obtain downwash information
- Develop model input files and select processing options
- Run model and analyze results

LDEQ Data Sources

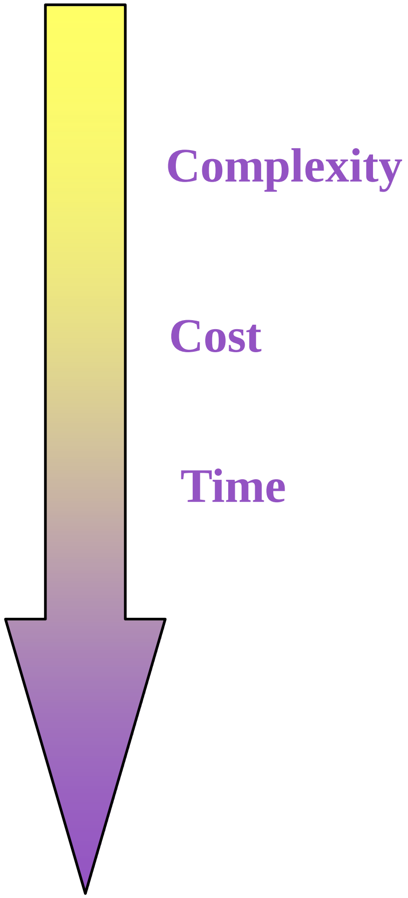
So What if I am building a new facility and need to do dispersion modeling? Here is my location:
30.416202,   -91.234500

Air Quality Analysis And Increment

- **Air Quality Analysis:** Demonstration that emissions from a proposed major stationary source or modification will not cause or contribute to a violation of a NAAQS or PSD increment.
  - Conduct an assessment of existing air quality, including ambient monitoring data and dispersion modeling
  - Evaluate impacts on Class I areas
- **PSD Increment:** The maximum allowable increase in pollutant concentration above a baseline concentration. To prevent air quality in clean areas from deteriorating to the NAAQS level. The baseline concentration is generally the ambient concentration existing at the time that the first complete PSD permit application affecting the area is submitted.

40 CFR Appendix W Air Models

- AERSCREEN (formerly SCREEN3)
  - Fast, conservative "screening model" Typically used for small projects
- AERMOD
  - Short range regulatory model (< 50 km)
  - Run by applicant
- CALPUFF
  - For visibility and long-range impacts
  - Run by applicant
  - Usually for Federal projects only



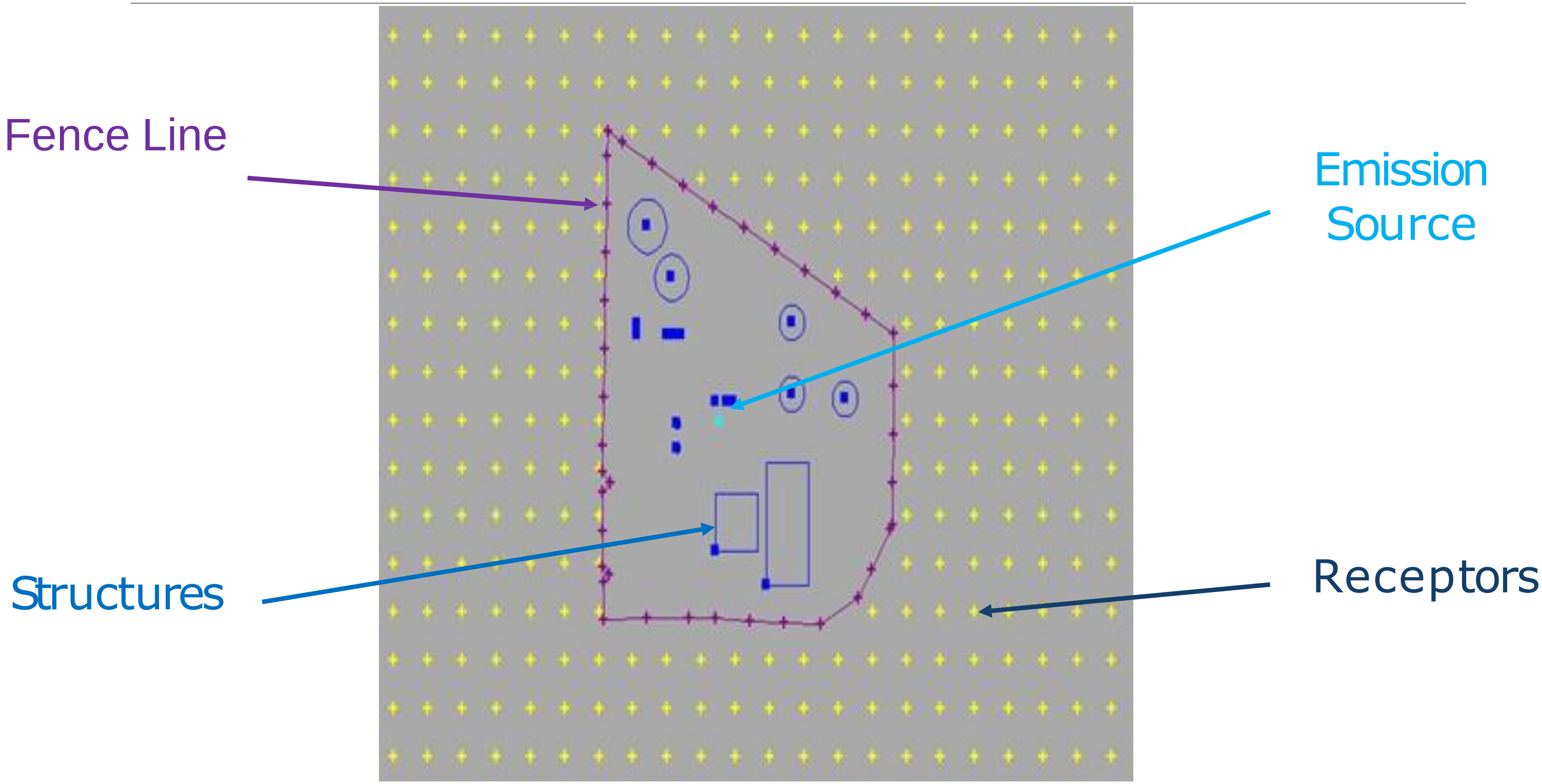
Modeling Definitions

- **Ambient Air**: portion of the atmosphere, external to buildings, to which the general public has access [40 CFR Part 50.1 (e)]. 2018 guidance: *"it is appropriate to exclude the atmosphere over land owned or controlled by the stationary source, where the owner or operator of the source employs measures, which may include physical barriers, that are effective in deterring or precluding access to the land by the general public*."

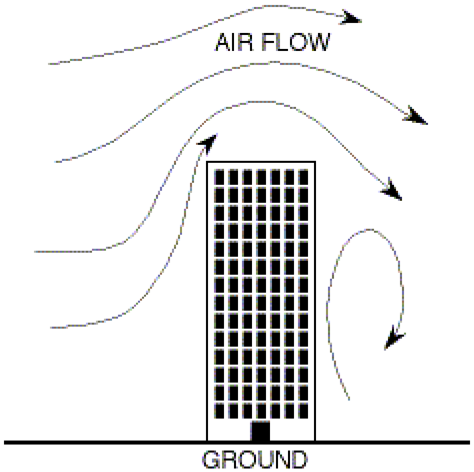
- **Good Engineering Practice (GEP) Stack Height**: the stack height at which building downwash no longer occurs
  - Cannot model a stack higher than GEP

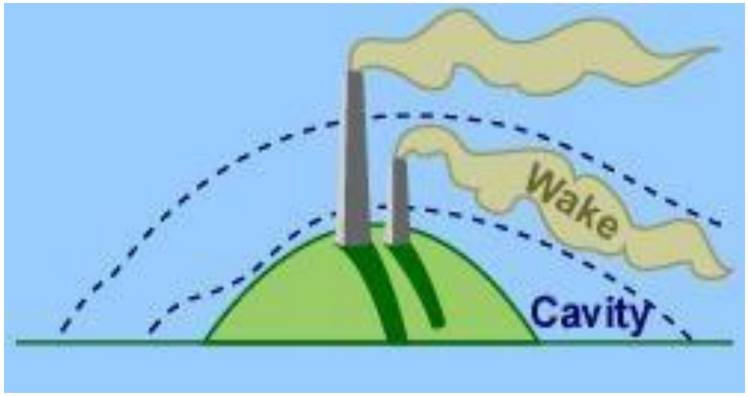
- **Background Concentration**: required to determine the ambient pollutant concentration
  - Includes sources not considered in modeling (e.g. mobile, non- point)
  - Obtained from ambient monitoring sites representative of the modeled source

Modeling Definitions



Modeling Definitions - Downwash



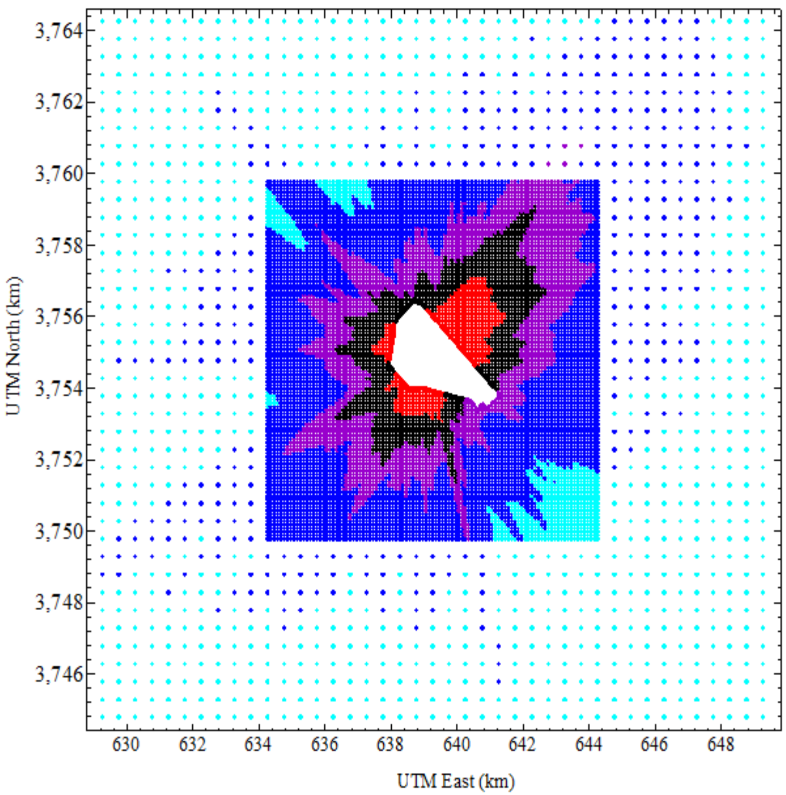


- In about 80% of all modeling cases, maximum concentrations occur at receptors affected by downwash

NAAQS Modeling Definitions

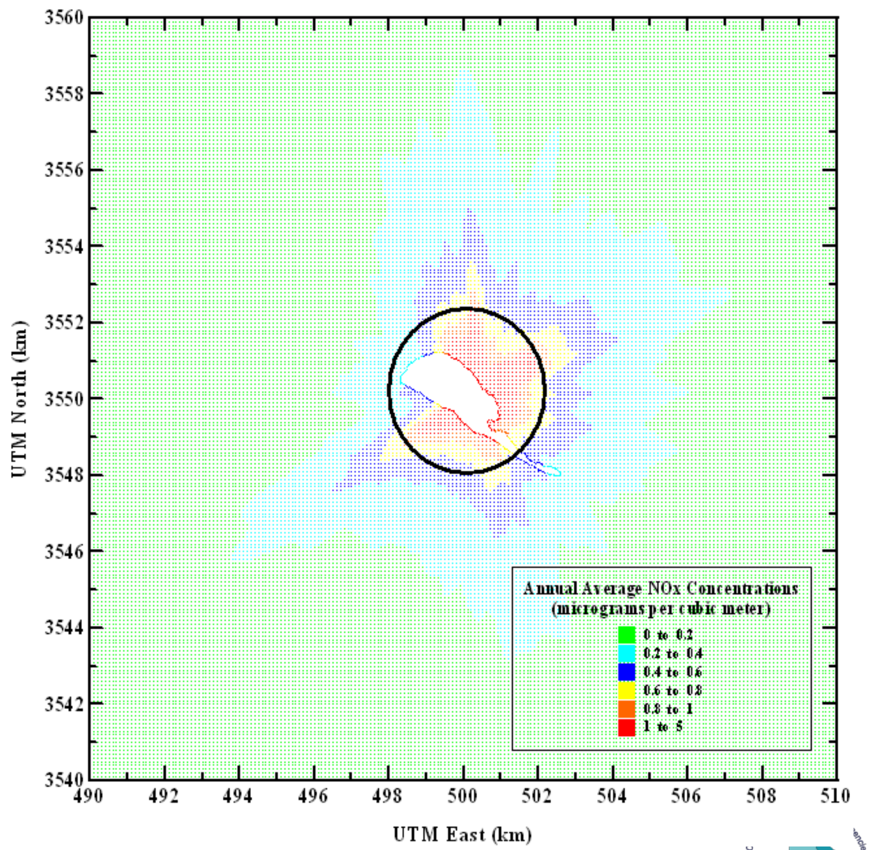
- Significance Analysis – Determining if new project has a "significant impact"

- SIL – Significant Impact Level



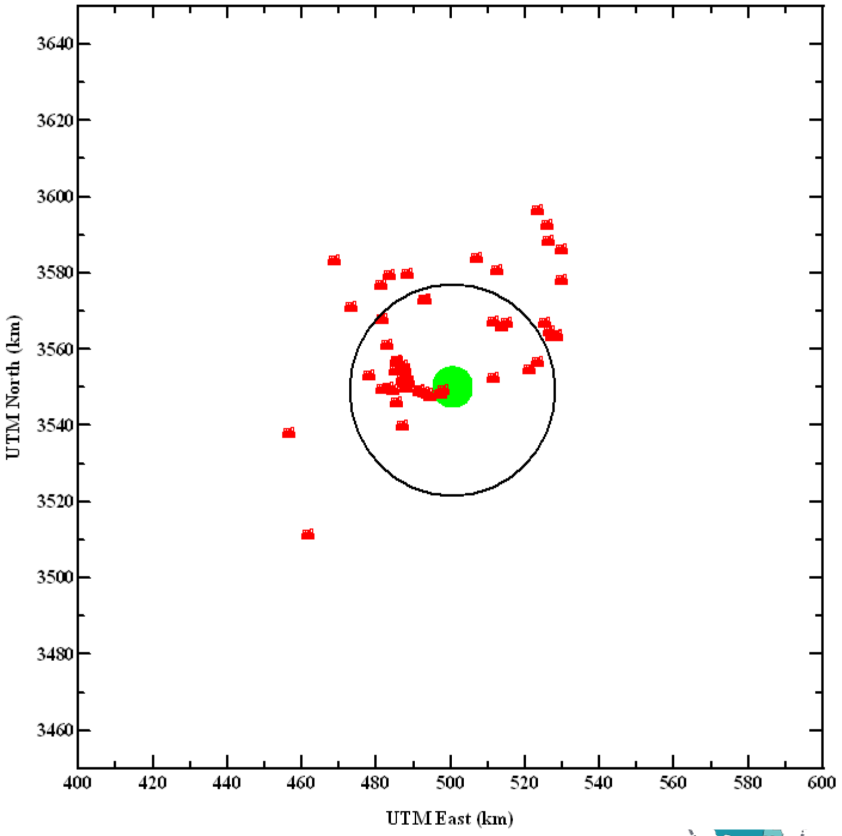
NAAQS Modeling Definitions

- ROI = Radius of Impact
  - Reaches furthest off site receptor
- SIA = Significant Impact Area – ROI cannot exceed 50 km due to model constraints

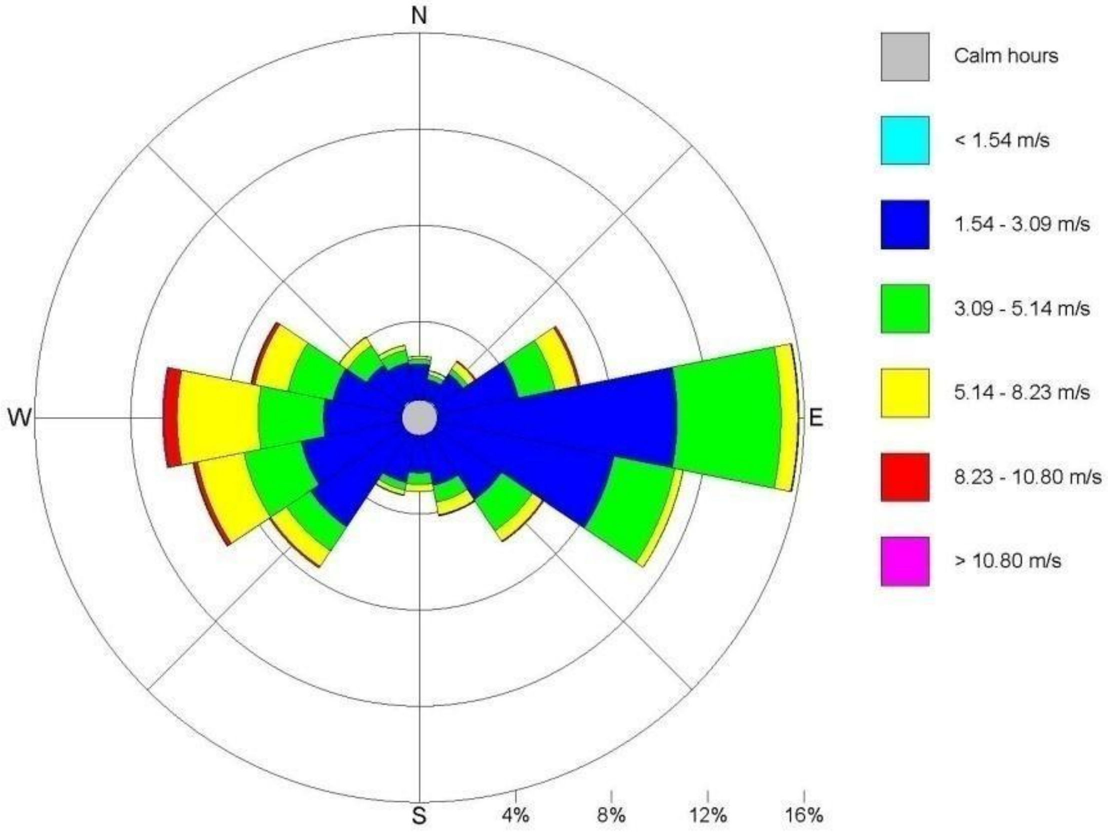


NAAQS Modeling Definitions

- Regional source inventory
- Model New Project + Regional source inventory
- Impact + background should be < NAAQS



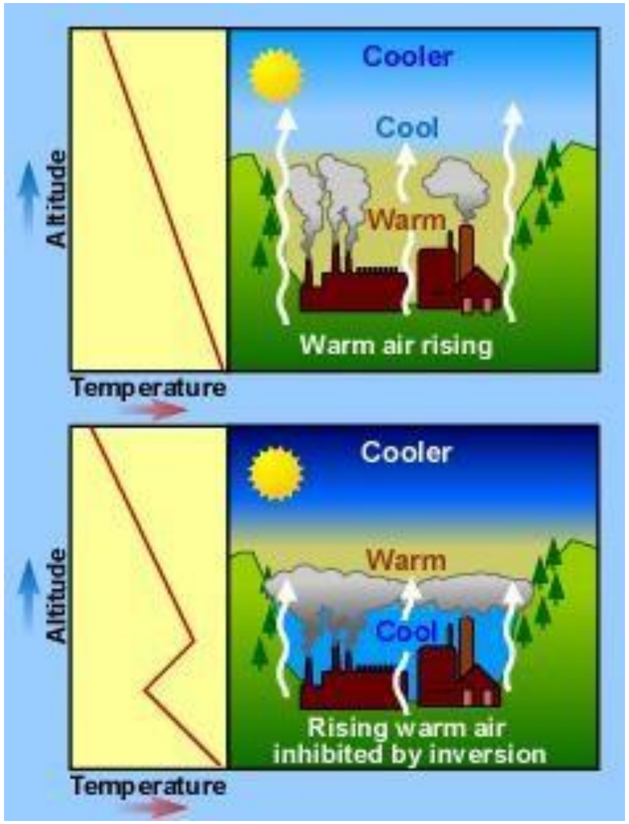
Critical Inputs – Meteorology

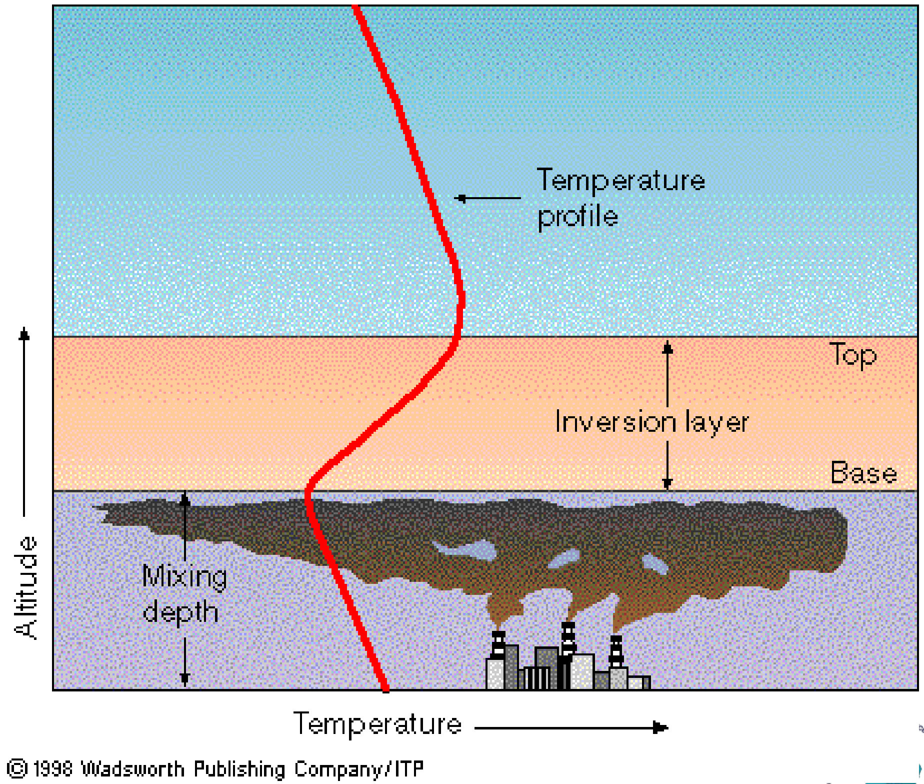


Presented in a circular format, the wind rose shows the frequency of winds blowing usually from particular directions. Each "spoke" around the circle is related to the frequency that the wind blows from a particular direction per unit time.

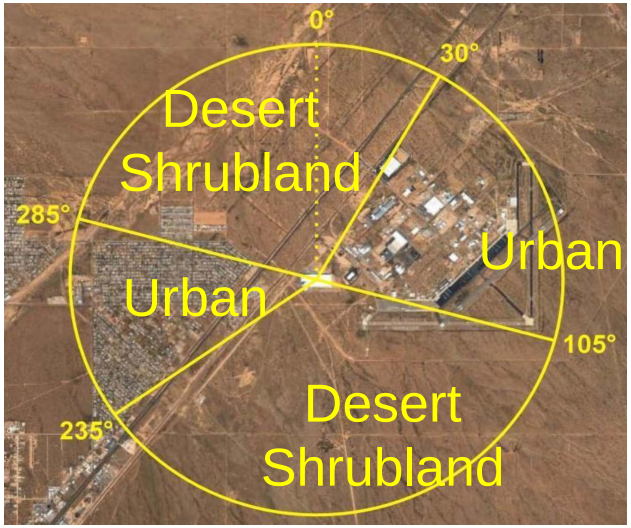
Critical Inputs – Meteorology

- Mixing height

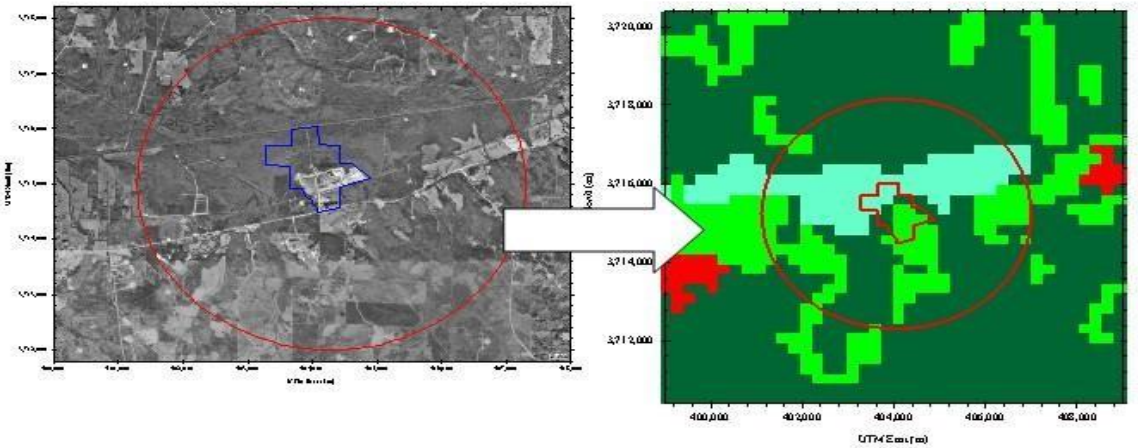




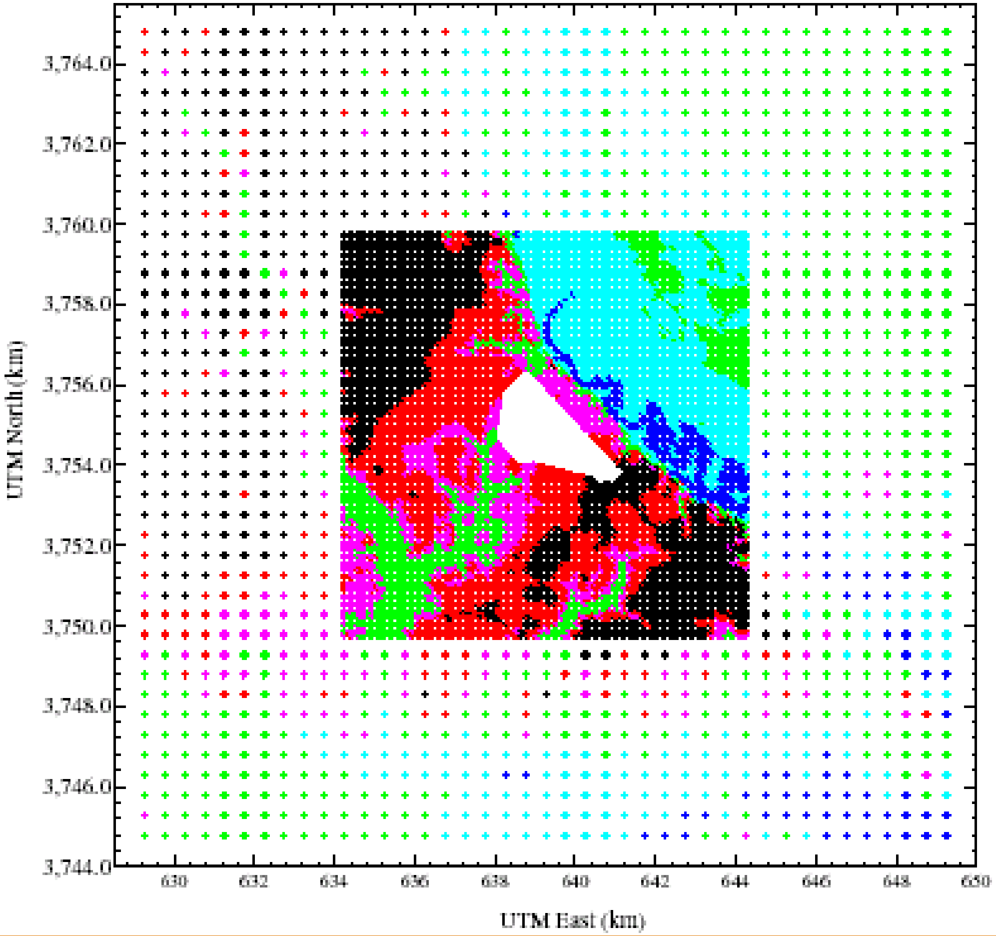
Critical Inputs – Landuse

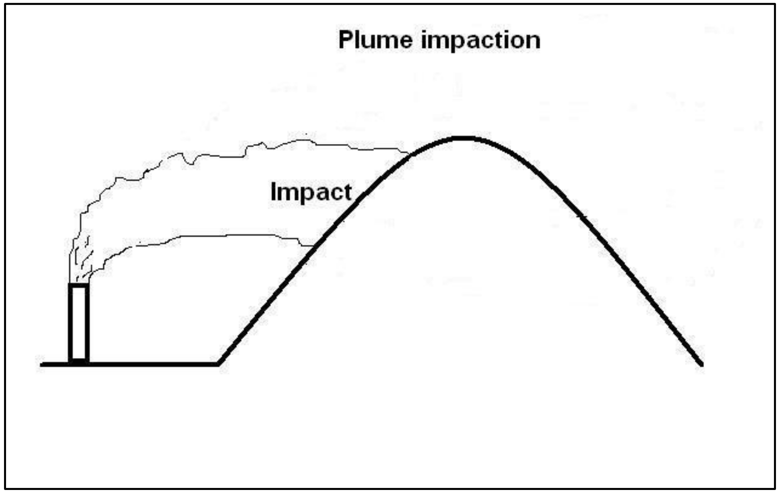


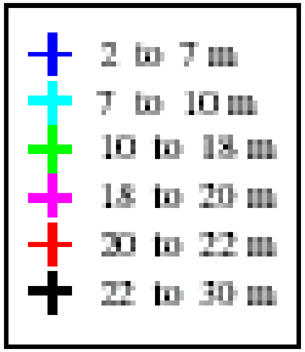
- Used to be performed manually
- Now performed using AERSURFACE



Critical Inputs – Elevations







Critical Inputs – Point Sources

- Stack location
- Horizontal/obstructed release
- Inside stack-tip diameter
- Exit velocity or flow rate (ACFM)
- Exit temperature
- Height above grade
- Pollutant and emission rate

Critical Inputs – Area Sources

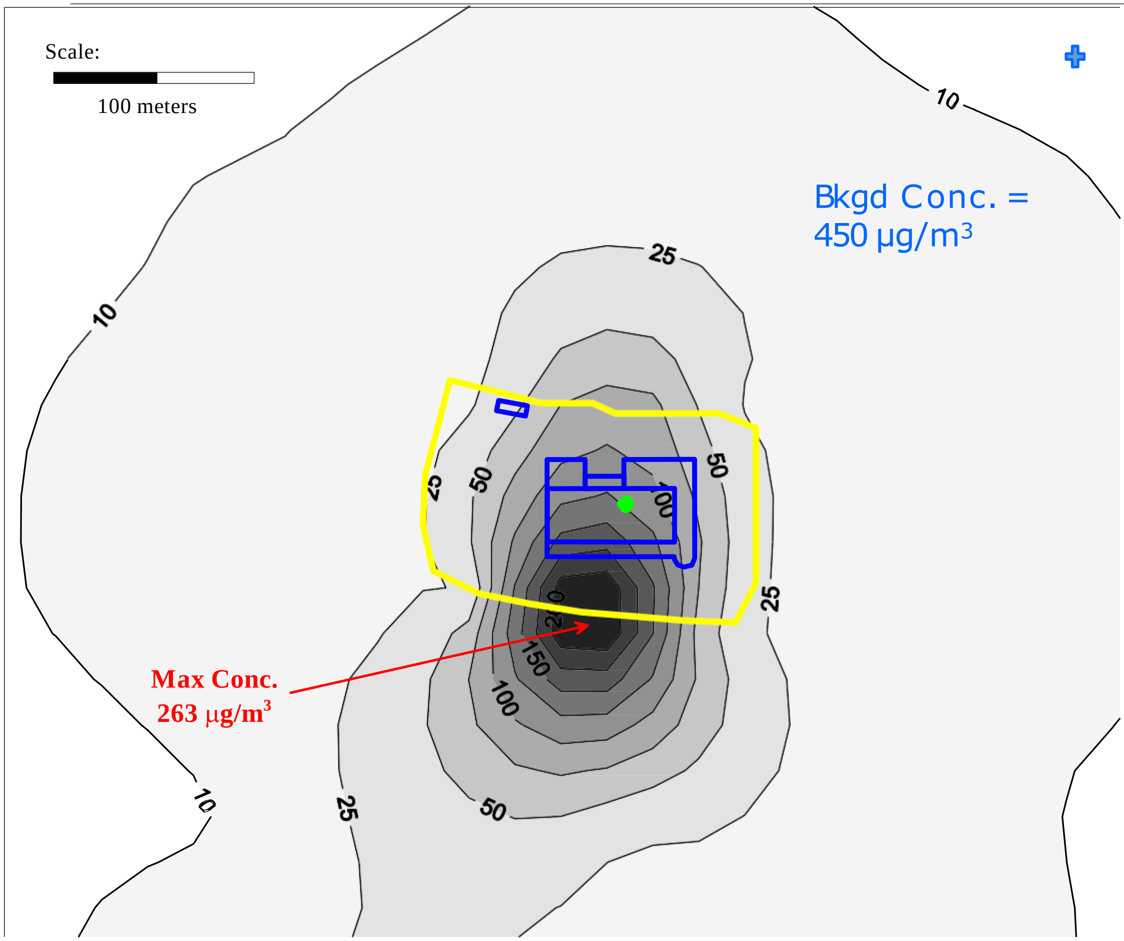
- Distinguishing characteristics
  - Fugitive releases
  - No plume rise
  - Evaporative sources
  - Storage Piles

- Required inputs
  - Emission rate per area
  - Coordinates and elevation
  - Release height above ground
  - Dimensions/shape/orientation

Critical Inputs – Volume Sources

- Distinguishing characteristics
  - Fugitive releases
  - No plume rise
  - Surface, obstructed, or elevated
  - Transfer points
  - Roof vents
  - Open buildings
- Required inputs
  - Emission rate
  - Coordinates and elevation
  - Release height above ground of volume center
  - Initial lateral and vertical dimension

NAAQS Analysis Example



Max. Conc.= 263 $\mu g/m^3$

Bkgd. Conc. = 450 $\mu g/m^3$

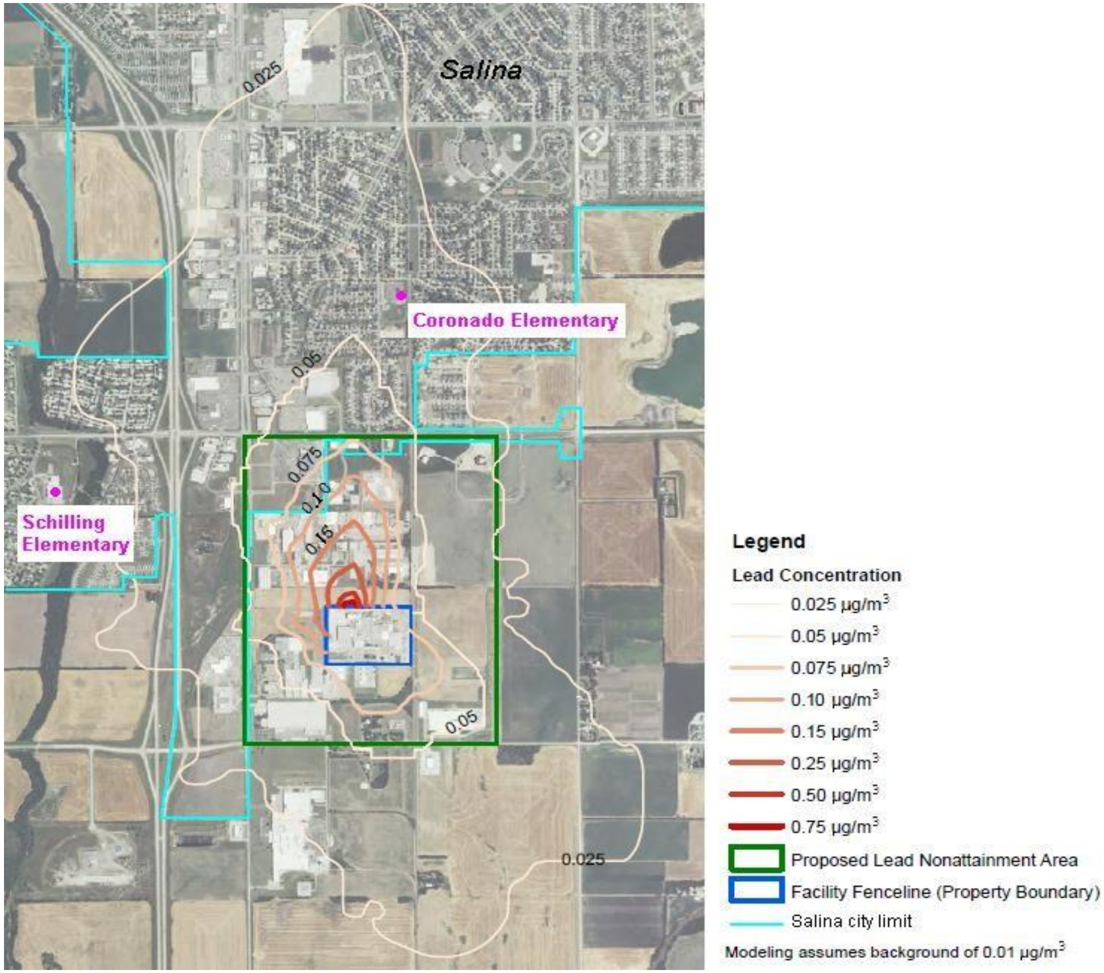
Total Conc. = 713 $\mu g/m^3$

NAAQS = 1,300 $\mu g/m^3$

Total Conc. < NAAQS

AERMOD result for annual NOx at proposed Kansas Biomass plant

Lead SIP dispersion modeling result



What could possibly go wrong?

- Potentially every step in the process
- Model code is updated frequently, sometimes resulting in significant changes
- Bugs in model
- NAAQS changes while permit is being prepared for public notice
- Changes in EPA guidance documents
- Problems with data received from source or consultant
  - Source location, stack location/height, diameter, flow rate
  - Emission rate
  - Sources strength
  - Quality of data on nearby sources

USEPA AQ models

- Screening models available at: http://www.epa.gov/scram001/dispersion_screening.htm
- Preferred models available at: http://www.epa.gov/scram001/dispersion_prefrec.htm
  - A single model found to outperform others
    - Selected on the basis of other factors such as past use, public familiarity, cost or resource requirements and availability
    - No further evaluation of a preferred model is required
- Alternative models available at: http://www.epa.gov/scram001/dispersion_alt.htm
  - Need to be evaluated from both a theoretical and a performance perspective before use
    - Compared to measured air quality data, the results indicate the alternative model performs better for the given application than a comparable preferred model
    - The preferred model is less appropriate for the specific application or there is no preferred model

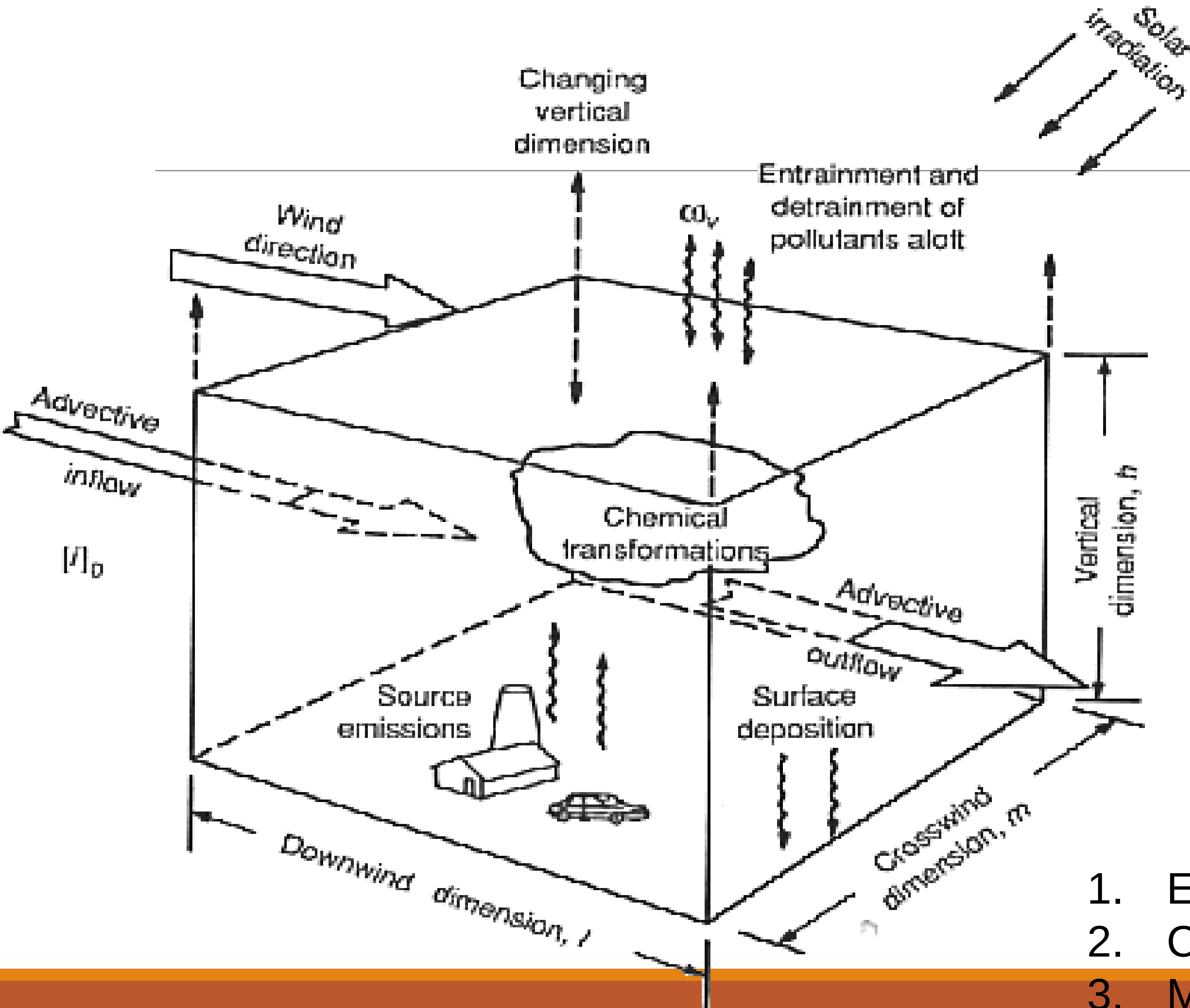
Photochemical Modeling

- Tool used to simulate chemical and meteorological processes that form ozone or PM
- Useful for determining long range transport impacts
- Model predicts concentrations for a selected historical episode
  - Important to pick correct episode for ozone
  - From days to years
- Modeled values are compared to monitored values
- Model results are used in a <u>relative</u> sense to overcome model errors such as bias.

Photochemical Model Processes

- Emissions
  - Surface emitted sources (on-road and non-road mobile, area, low-level point, biogenic, fires)
  - Point sources (electrical generation, industrial, other, fires)
- Advection (Transport by wind)
- Dispersion (Diffusion)
- Chemical Transformation
  - VOC and NOx chemistry, hydroxy radical cycle
- Deposition
  - Dry deposition (gas and particles)
  - Wet deposition (gas and particles)

How it all works



1. Emissions
2. Chemical reactions
3. Meteorology

Photochemical Modeling System

- Emissions Modeling - *How do the emissions behave?*
  - EPS2x, SMOKE and EMS-2001
- Meteorological Modeling - *What's the weather like?*
  - WRF, MM5, RAMS (SAIMM and CALMET)
- Preprocessors for Other Inputs
  - TUV (photolysis rates)
  - Initial concentrations and boundary conditions
- Air Quality Model - *What happens when it all gets mixed up?*
  - CAMx, CMAQ, UAM-V
- Post-Processors and Visualization
  - Model performance evaluation (CAMXtrct, Excel, SURFER)
  - PAVE

Photochemical Modeling Steps

- Select model – UAM-v, CAMx, CMAQ, etc.
- Select modeling episode
  - Based on meteorology and emissions
- Create modeling domain
- Create emission inventory
- Conduct meteorological modeling
- Perform emissions modeling –spatial and temporal allocation
- Input met model and emissions modeling results
- Press ENTER

Photochemical Modeling Process

- Replicate historic episodes to establish acceptable model performance (base case)
- Tweak inventory or met data to achieve desired performance
  - Perform quality assurance analysis on model results
- Substitute projected emission estimates to establish "future" conditions
  - Use economic growth models for each industry sector
- Test effects of various control strategies on future case
- Use probing tools to determine impacts of source categories
- Determine emissions reduction target for future attainment
- Develop model attainment strategy

Key Photochemical Reactions

<u>NOx Reactions</u>

$NO + O_3$	→	$NO_2 + O_2$	(NO-O_3 titration)
$NO_2 + \eta\nu$	→	$NO +$	(NO_2 photolysis --
$O + O_2$	→	O O_3	sunlight) (Ozone
			Formation)

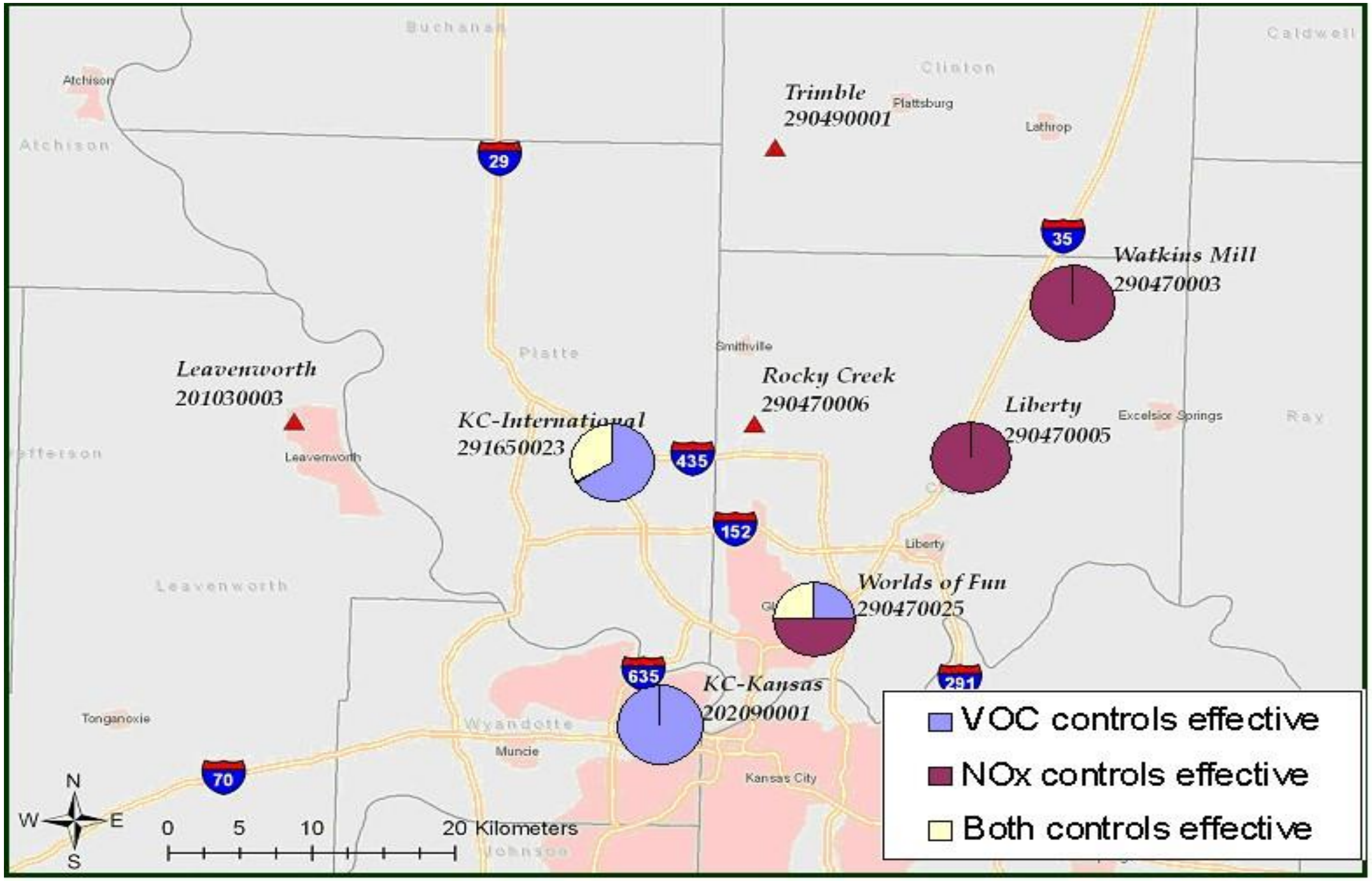
<u>VOC-Radical Reactions</u>

$VOC + OH$	→	$VOC + HO_2$	(OH to HO_2 w/o NO_2 destruction)
$HO_2 + NO$	→	$OH + NO_2$	(NO to NO_2 w/o O_3
$HO_2 + HO_2$	→	$H_2O_2 + O_2$	destruction) (H_2O_2 Formation)

<u>Secondary PM Reactions</u>

$NO_2 + OH$	→	HNO_3	(Nitrate Formation -- Day)
$N_2O_5 + H_2O$	→	HNO_3	(Nitrate formation – Night)
$SO_2 + OH$	→	$SO_4 + HO_2$	(Sulfate Formation – Gas-
$SO_2 + H_2O_2$	→	SO_4	Phase)
			(Sulfate Formation – Aqueous)
$SO_2 + O_3$	→	SO_4	(Sulfate Formation – Aqueous)
HNO_3 (g)	←→	NO_3 (pm)	(Equilibrium – NH_3, SO_4)

Model output visualization…
What Controls are Effective?



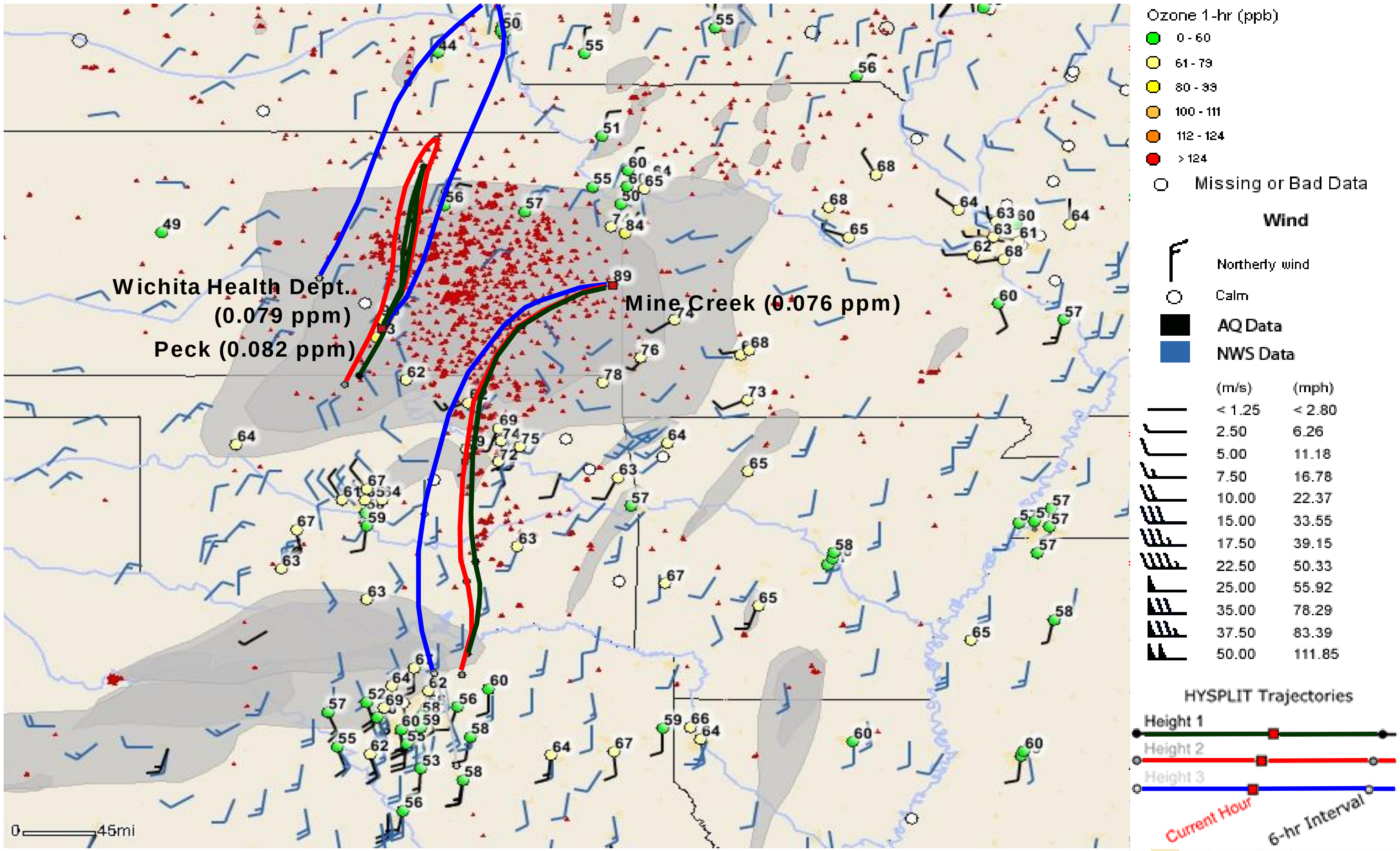
“Probing” Tools

- A module within the model that can extract information on source-receptor relationships
- Used to diagnose model to understand why it is getting the answer it gets and improve modeling performance
- Used to improve emission control strategies
- Ozone Source Apportionment Technology (OSAT) – ozone source apportionment by source
- Particulate Source Apportionment Technology (PSAT)
- Process Analysis – output information on chemical processes and mass flux (also in CMAQ)

HYSPLIT

- NOAA Air Resources Laboratory
- HYbrid Single-Particle Lagrangian Integrated Trajectory model
- Multiple features
  - Computes forward and backward air parcel trajectories
  - 3D particle dispersion or splitting puffs
  - Can link to multiple meteorological forecasts and data sets
  - Can easily be run on web site or downloaded

- http://www.arl.noaa.gov/HYSPLIT_info.php



24-hour backward HYSPLIT trajectories ending at 16:00 on April 6, 2011.
Red dots and gray shading show cumulative daily fire and smoke locations, respectively.
Southerly winds transported smoke to the Mine Creek monitor.
Northerly winds transported smoke from the northern Flint Hills into the Wichita area monitors.

SMOKE MANAGEMENT

Home | About Us | Environment | Implementation | Education | Health | Events | Weather | Models

About | Cumulative Fire Impacts | Your Fire Impacts

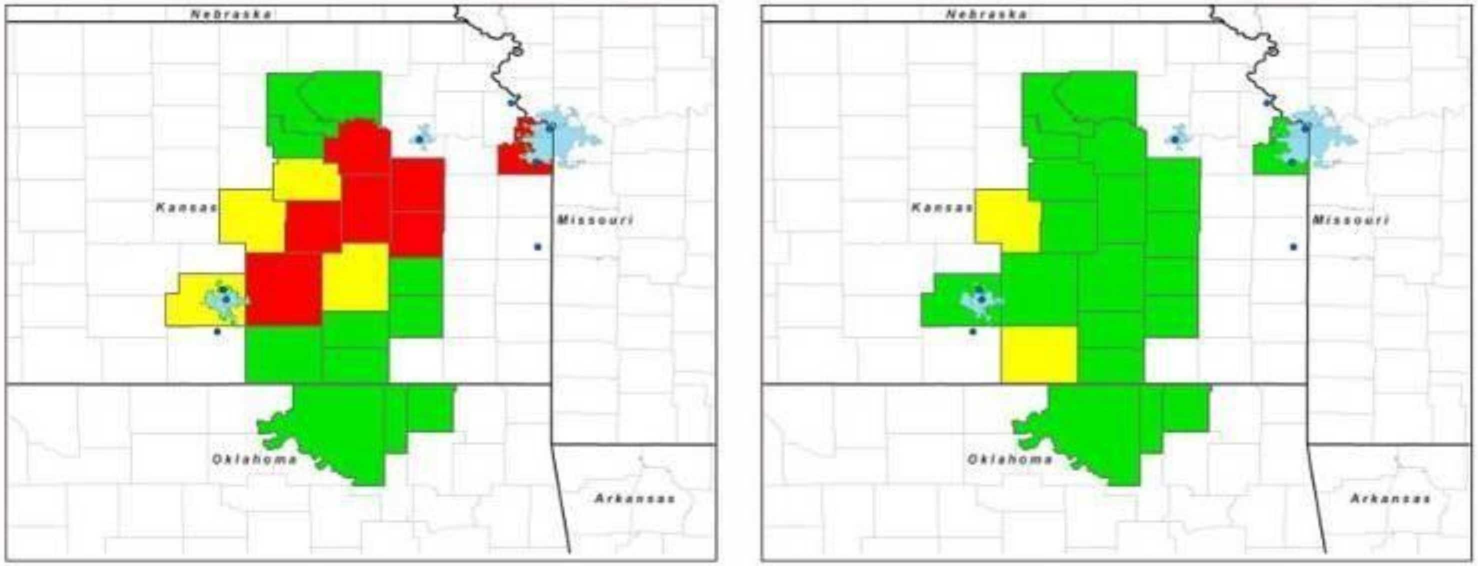
Forecasts and maps are updated daily at 1pm CDT. Note, the map for April 05, 2011, will not be available after 1pm CDT.

View as: **Map** | Table

Potential Contribution To Major Cities For Fires Ignited On

April 06, 2011 | **April 07, 2011**

Maximum Contribution Potential within 48 hours



Small Contribution | Medium Contribution | Large Contribution | Data Unavailable | Metropolitan Area | Monitor

Forecast Discussion

Wednesday, April 6: Moderate southwesterly winds in the morning will become east-northeasterly by mid-day as a low-pressure system moves east through Oklahoma. These conditions will cause smoke from potential fires in the Flint Hills to initially be transported into the Topeka and Kansas City areas before moving back toward Wichita later in the day.

Thursday, April 7: A low-pressure system over western Kansas will generate moderate south-southeasterly winds in the eastern portion of the state. These winds will transport any smoke from potential fires in the Flint Hills away from Wichita, Topeka, and Kansas City.

Extended Forecast

This forecast is for air quality impacts only.

April 8, 2011: Worsening conditions for burning are expected.
April 9, 2011: Worsening conditions for burning are expected.
April 10, 2011: Improved conditions for burning are expected.
April 11, 2011: Improved conditions for burning are expected.

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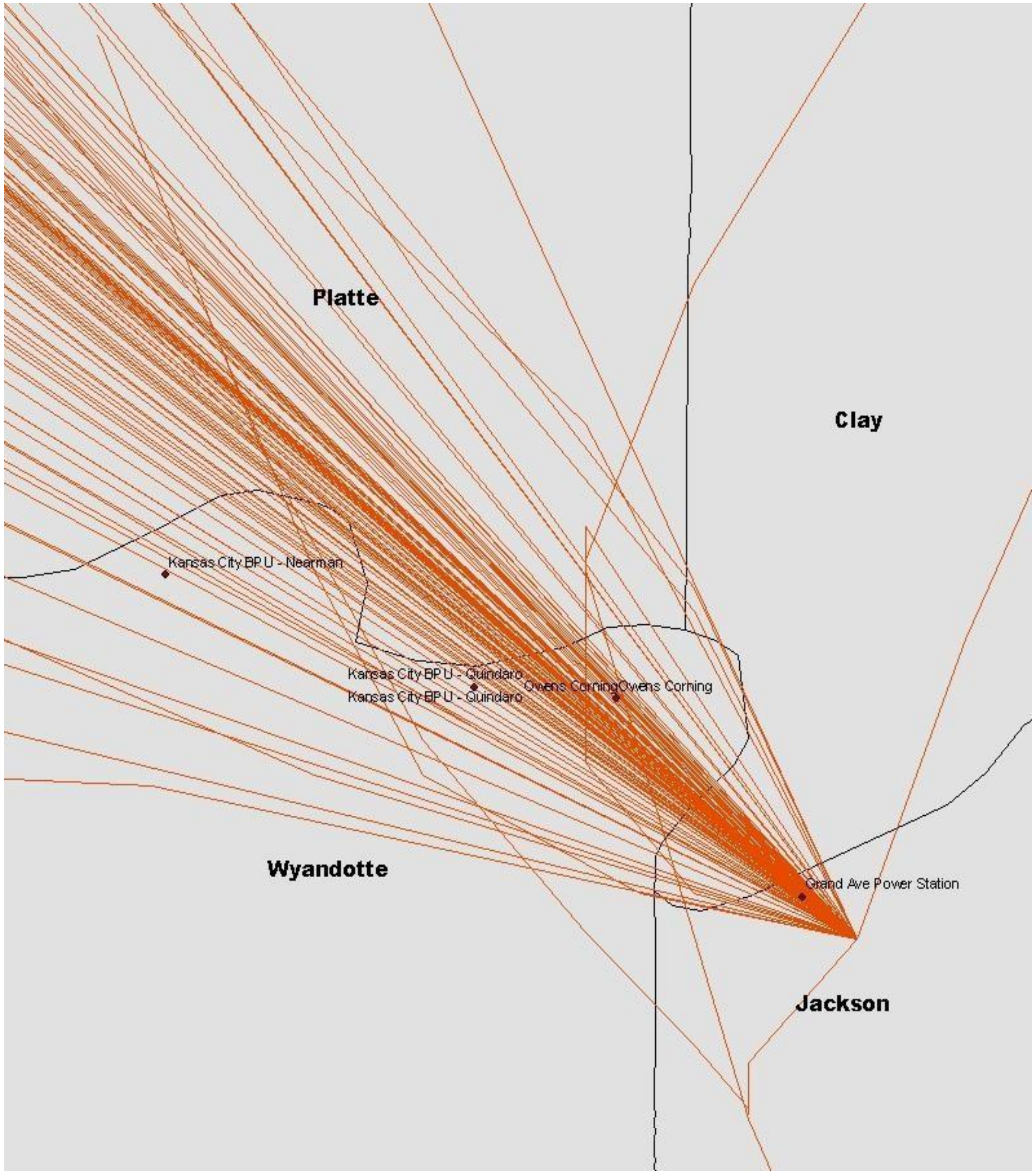
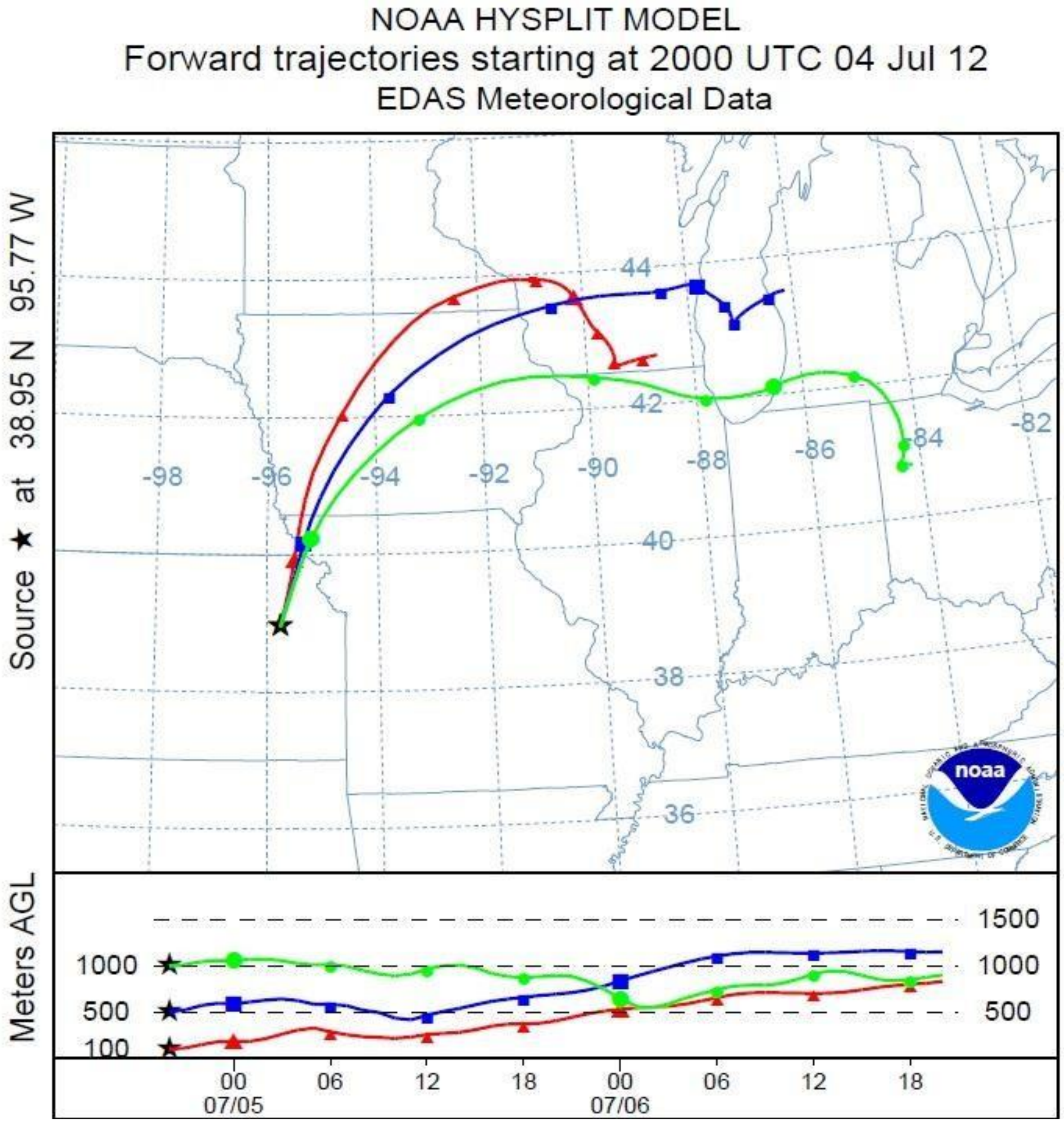
KC SO_2 HYSPLIT worst days back trajectory cluster



Emissions pathway of 4th of July Celebration



Modeling Summary

- Modeling requires many inputs
  - Emissions, Meteorology, surface conditions, Boundary and Initial Conditions, Photolysis rates, etc.
- Chemistry is key in NO_x/VOC sensitivity
- SIP quality modeling requires additional work
  - Performance evaluation
  - Growth and control for future years
  - Control Strategy evaluations
  - An attainment demonstration

New Source Review Permits

Prevention of Significant Deterioration (PSD)

- Construction permitting program applies to major sources of regulated pollutants in attainment and unclassifiable areas
- Following cannot be constructed without first obtaining a PSD permit:
  - New Major Source
  - Major modification to a non-major source
  - Significant modification to a major source
  - NOTE: Requires evaluation of all "regulated NSR pollutants", not just criteria pollutants

PSD New Source Review

- Emissions must be well controlled
  - Best Available Control Technology (BACT)
- Emissions cannot cause:
  - Exceedance of the “increment,” (NO_x, SO_2, PM), nor
  - Cause or contribute to a NAAQS violation
  - Demonstrated through modeling
- Preconstruction monitoring
- Complex regulation
  - 40 CFR §52.21 (most states’ PSD rules are identical or very similar)

Major Source

- Determined by the Potential to Emit (PTE) of the source
- PSD - (Any "regulated NSR pollutant")
  - 100 TPY (listed sources categories)
  - 250 TPY
  - In order to be considered PSD for CO2, you must trigger for another pollutant
- Non-attainment NSR - (Pollutant for which the area is designated nonattainment)
  - 100 TPY , except
  - Depending on pollutant and classification, it may be 10 TPY - 70 TPY

Calculating Potential-to-Emit (PTE)

- PTE is calculated as the maximum a plant could emit if it operated 24 hours per day, 365 days per year at its maximum emissions rate, kinda
  - Emissions factors
  - Material Balance
  - Software ….. TANKS
  - Engineering Judgment
- It is calculated separately for each pollutant
- It can be reduced by placing enforceable controls on the plant
  - Permits
    - Synthetic minors
  - Regulations
  - Consent decrees and other enforceable documents
- Sometimes you include fugitive emissions, sometimes you don't
  - Fugitives for Listed Sources are included, or if regulated under Section 111 or 112 standards as of 1980…otherwise, no

Minor Source NSR

- Each state is required to have a minor NSR program
- General federal guidelines for states
  - EPA has issued Tribal NSR guidelines
  - State programs vary substantially as they evolved
  - 40 CFR 51 Subpart I
- Like NA-NSR and PSD, the purpose is to assure compliance with the NAAQS
- States also have general regulations adopted as part of the SIP
  - I.e., an Opacity regulation
  - Usually some general criteria pollutant related regulations applicable to all sources

Title V Operating Permits

Title V Operating Permits

- By 1990, the air quality program, in its current form, had been around since 1970
- It was becoming difficult to determine the compliance status for many sources
- Also, old regulations and permits often contained no method for determining on-going compliance
- Congress addressed these issues in Title V of the 1990 Clean Air Act Amendments (CAAA)

Title V Purpose

- Enable the source, States, EPA, and the public to understand the requirements for the source
- Aid in determining whether the source is meeting those requirements
- Increase source accountability
- Provide for better emission inventories
- Provide a vehicle for States to administer parts of the Federal air toxics program and the acid rain program
- Help ensure compliance with the acid rain regulations promulgated under Title IV of the Act

Title V Operating Permits

- Regulations specifying requirements for state Title V programs found at 40 CFR Part 70
- Who has to get a Title V permit?
  - Major sources of “regulated air pollutants”
    - Discuss the role of SYNTHETIC MINOR permits in the air quality program
  - Non-major, if the applicable regulation requires
  - Affected sources
  - Solid waste incinerators required to obtain a permit under Sec. 129 of the CAA
  - Air curtain destructors required to obtain a permit under Sec. 111 of the CAA
- All applicable requirements for all regulated air pollutants must be included in the Title V permit

Title V Thresholds

- Title V - (Any "regulated air pollutant")
  - PM_{10}, NO_x, SO_2, CO, VOC – 100 TPY
    - Except may be 10 TPY - 70 TPY depending on pollutant and nonattainment area classification
- HAPs - (Listed HAPs)
  - 10 TPY for a single HAP
  - 25 TPY for a combination of HAPs

What are Applicable Requirements?

- Federal air quality requirement (NSPS, NESHAP, Acid Rain, Stratospheric Ozone, etc.)
- SIP requirements
- Compliance Assurance Monitoring
- Permit requirement, if the permit is issued pursuant to the SIP or federal air quality program

Title V Operating Permits

- Each state must develop and use a standard application form
  - Affected sources must use the federal form for Acid Rain requirements
- One of the unique requirements of the Title V program was the emissions fee requirement
  - The state Title V program is required to be completely funded using emissions fees paid by the Title V sources
  - Ensure that States have resources necessary to develop and administer the program effectively
  - Create an incentive for sources to reduce emissions…maybe

Title V Program

- Title V is a very prescriptive program specifying:
  - What must be included in applications
  - Time limits within which actions must occur
  - Documents and information the source must submit
  - Who must sign the document
  - Compliance certifications and plans
  - Permit content
  - Permit renewal or modification procedures
  - etc.

Title V Concepts And Terms

- Application shield
- Permit shield
- Responsible official
- Affected states
- EPA objection
- Statement of Basis
- FESOPs - Federal Enforceable State Operating Permits

Compliance Assurance Monitoring (CAM)

- EPA rules before 1990, most state SIP rules and permits did not specify how a source demonstrated continuous compliance
  - Most only specified initial compliance methodologies
  - Federal Reference Test methods (Appendix to 40 CFR Part 60)
- EPA essentially presumed that everything pre-CAM was inadequate
- The CAM rule required that certain sources demonstrate compliance on a continual basis
- Accomplished through the Title V permit

Compliance Assurance Monitoring

- CAM applies to a source's emission unit that:
  - Has a limit or standard
  - Uses control equipment to comply with applicable requirement
  - If uncontrolled PTE of the emissions unit exceeded the major source threshold
    - (If the uncontrolled PTE was less than the major source threshold, Periodic Monitoring was required, such as annual source testing)

Common methods to satisfy the CAM requirement

CEMs/COMs

- Measures Opacity

Continuous Parametric Monitoring System (CPMS)

- Measures a parameter that is indicative of system performance

Predictive Emissions Monitoring System (PEMS)

- By monitoring emissions from hybrid technologies, empirical calculations and historic and real-time emissions, PREDICTIVE of what is happening

Title V also brought us

- Small Business Assistance Program (SBAP)
  - Title V required states to set up a SBAP
  - Due to concerns that MACT standards would apply to many small sources that were newly regulated
  - SBAP works very well in some states and not in others
- Risk Management Plans (RMPs)
  - Required by Section 112(r) of the CAA
  - Facilities with HAPS above thresholds required to develop and share plans with local response officials
  - CAA response to Bhopal release

Title V Operating Permits

- The Title V permit is intended to be the document that everyone uses to determine the compliance status of a source

- Federal oversight authority:
  - Object to a permit and issue an EPA permit under 40 CFR Part 71
  - Revoke approval of the state's Title V program and institute a federal program for that state
  - Withhold highway funds

Title V Operating Permits Class Exercise

- Why is the concept of “applicable requirements” important to the Title V Operating permit program?
- What is an applicable requirement?
- Which of the following are applicable requirements?
  - A BACT requirement?
  - A LAER requirement?
  - Terms and conditions of a minor NSR permit?
  - A BART requirement?
  - A requirement that office air conditioning units be maintained by a licensed technician?
  - A state rule?
  - A New Year’s Resolution?
  - A requirement that an affected source operate it CEMs according to the requirements of 40 CFR Part 72.
  - A requirement that all asbestos abatement projects meet the requirements of 40 CFR Part 61?
  - A severability clause required by Title V of the CAA?
  - An NSPS or NESHAP requirement?
  - A consent decree order entered into between the state and the source?

Compliance Monitoring

- https://www.youtube.com/watch?v=N7tLcPQk3PA
- https://www.youtube.com/watch?v=h7RMzdTTcVk&feature=youtu.be
- https://www.youtube.com/watch?v=8ZZsQBfXoPI&list=PL9BS7nDf-8tp79KUiH5wQQyuoiLt8C6UU&index=6&t=0s
- https://www.momscleanairforce.org/making-methane-visible-in-texas-permian-basin-fracking-boom/
- https://www.infraredtraining.com/view/index-id=60710.html#recorded

FLIR Optical VOC Imaging

TCEQ Optical Gas Imaging Camera Program for Censara 101 Clearing the Air

SUMMARY AND PROGRAM BASICS

Acronyms to know

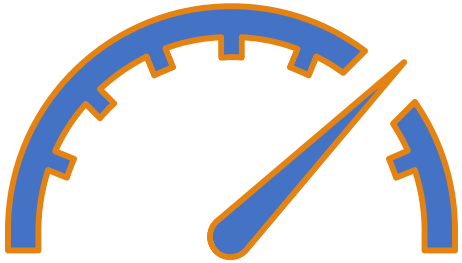
OGIC – OPTICAL GAS IMAGING CAMERA

IR – INFRARED

VOC – VOLATILE ORGANIC COMPOUND

TCEQ OGIC Program Updates

- Approximately 200 operators have received OGIC certification through the Agency
- 4 operators currently certified in advanced thermography training from the Infrared Training Center (instructor training arm of FLIR Systems)
- Agency currently has approximately 150 Infrared Training Center (ITC) and / or TCEQ certified OGIC operators
  - 3 advanced technical staff are Level III certified thermographers
- Infrared Technical Workgroup composed of representation from Regions 1, 4, 11, 12, 14, and Monitoring Division and the Program Support Section
- OGIC equipment distributed to ensure business needs are met in all regional offices



Basics of Agency OGIC Use

- OGICS PROVIDE AGENCY UNIQUE AND POWERFUL TOOL TO LOCATE SOURCES OF VOC EMISSIONS.
- TECHNOLOGY USES A PASSIVE, IR CAMERA TO "SEE" EMISSIONS OF VOCS IN AMBIENT AIR BASED ON IR FILTER AND TEMPERATURE / EMISSIVITY DIFFERENCES OR PLUME MOVEMENT
- USE ALLOWS TCEQ STAFF TO EFFECTIVELY AND QUICKLY COMMUNICATE POTENTIAL UNAUTHORIZED EMISSIONS TO FACILITY PERSONNEL
- REQUIRES GENERAL UNDERSTANDING OF THERMODYNAMICS WHEN THERE IS A CONVERSION / TRANSFER OF HEAT VIA CONDUCTION, CONVECTION, OR RADIATION
- TCEQ HAS BEEN INVOLVED WITH GROUND-BASED OGIC IMAGING SINCE 2005

- TCEQ PROGRAM PROVIDES SAME BACKGROUND ON PRINCIPLES OF THERMOGRAPHY THAT THE MANUFACTURER TRAINING COVERS, BUT ALSO FOCUSES ON FUNDAMENTAL NEED TO MAINTAIN INTEGRITY AND DEFENSIBILITY OF FINDINGS

- COURSE INCLUDES 11 MODULES
    - General discussion-history, case studies, success stories
    - Science – OGIC setup and operation, thermal science, heat transfer, IR theory, VOC absorption characteristics, and temperature measurements
    - Agency protocols – applicable documents and procedures and survey and report procedures

TCEQ OGIC Certification Program

- INFRARED THERMOGRAPHY – *PROCESS OF ACQUISITION AND ANALYSIS OF THERMAL RADIATION FROM NON-CONTACT THERMAL IMAGING DEVICES*
- IS DIVERSE AREA OF TECHNICAL EXPERTISE THAT INVOLVES THE SKILLS
  - Camera handling
  - Thermal Science – differences between temperature, heat, and energy. Understanding of laws and theories.
  - Radiation science – Interpreting surface temperature patterns. Measuring surface temperatures and Delta temperatures.
  - Analysis techniques – interpreting images based on infrared science and heat transfer.
  - Applications – moisture inspections, building and roof inspections, electrical surveys,

What Is Thermography?

TCEQ recently acquired 2 state-of-the-art FLIR GF620s

2016 Eagle Ford Shale Formation Flyover

Acid Rain Program

Acid Rain

- Title IV of the 1990 CAAA created a new program to control acid deposition
- To reduce acidification of soil and waters by EGU NO_x and SO_2 emissions
  - Primarily in eastern US and Canadian shield
- Title IV specified sources and the methods of control
- Sources subject to the Acid Rain program are referred to as “Affected Sources”
  - Large coal burning electric utilities
  - Existing coal, oil and gas electrical generators > 25 megawatt capacity
  - All new coal, oil and gas fired utility units

Acid Rain

- Acid Rain program regulations are in 40 CFR Parts 72 through 78
- NO_x emissions were to be regulated by "command and control" strategies
  - EPA developed regulations setting out the NO_x emission limits sources must meet
- SO_2 emissions were to be regulated by a market based "cap and trade" strategy

SO_2 Cap And Trade Program

- Covers very large region….eastern US
- Total SO_x emissions allowed by sources is the "cap"
- SO_2 allowances allocated to sources based on previous emissions and program goals
  - One allowance equals one ton of SO_x emissions
- Each source required to hold one allowance for each ton of SO_x emitted in the prior year
- Sources can generate allowances to trade (sell) by reducing emissions below their allowances
- Accounting occurs annually
- Allowances are traded in the open market

SO_2 Cap And Trade Program

- EPA periodically reduced allowances, thereby further reducing SO_x emissions
- EPA maintains primary control of this program
- Emissions accounted for through CEMs
- State/local involvement is:
  - Primarily observing RATAs
  - Folding the Acid Rain requirements into Title V permits
- Acid Rain program has its own permits, applications and notification forms
- Has been a cost-effective means of reducing acid rain

Acid Rain Class Exercise

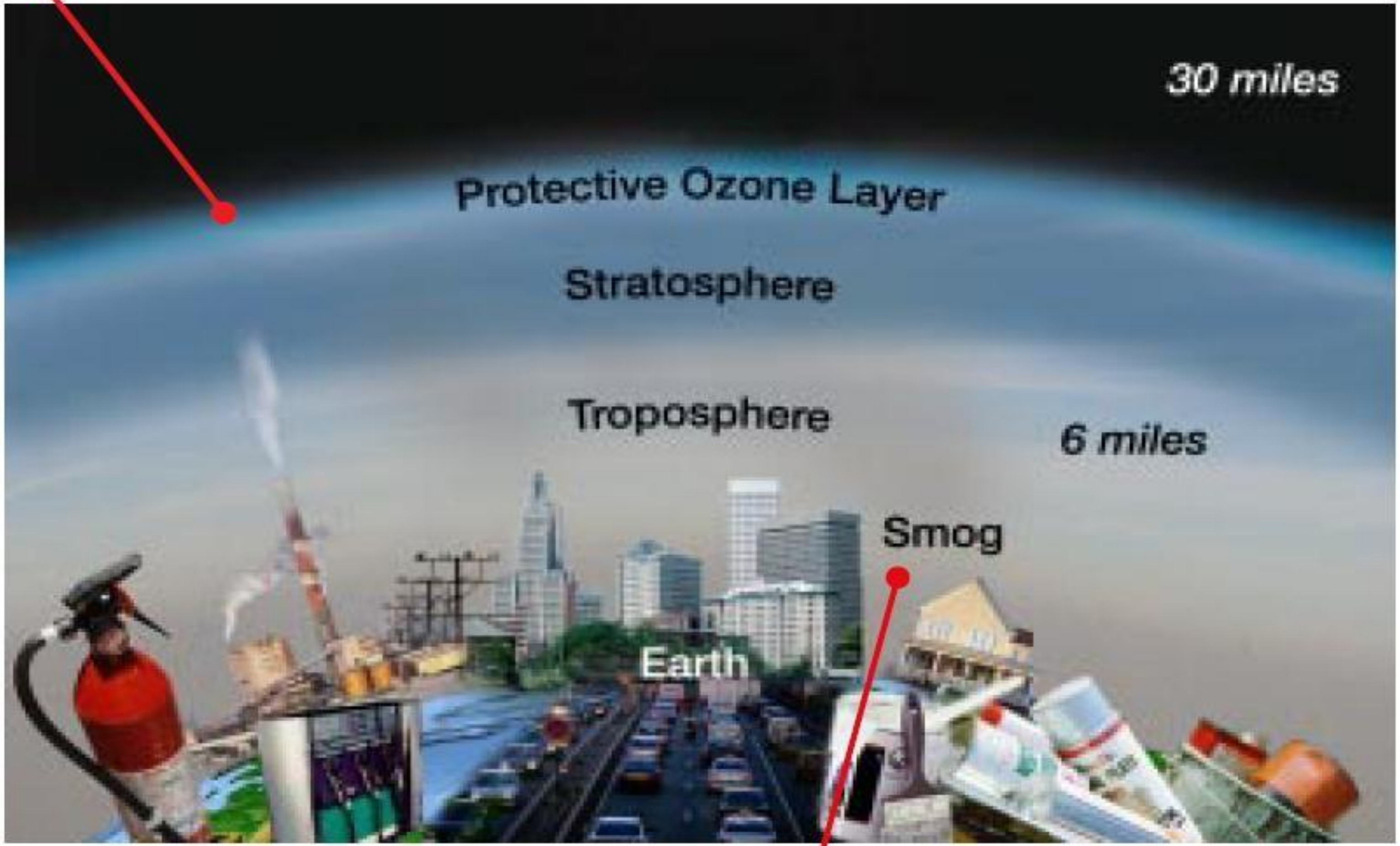
- For Class discussion:
  - A PSD permit requires a SO_2 source to control its emissions at a rate which would not allow total SO_2 emissions to exceed 5,000 tons per year.
  - The source is an affected source and holds 6,000 tons of federally issued SO_2 allowances.
  - At the end of the year, the source has emitted 5,500 tons of SO_2.
  - Can an enforcement action be brought against the source?

Interstate and International Issues

International Issues

- Primary international issue was Stratospheric Ozone depletion
  - Stratospheric ozone layer blocks ultraviolet rays from the sun
  - Linked to possible increases in skin cancer
  - 27 countries came together and signed an agreement
  - Title VI of the 1990 CAAA gave EPA the authority to regulate ozone depleting substances
  - The model for addressing international air pollution issues
- Other international air pollution issues evolved
  - Climate change …. Kyoto protocol – US did not sign
  - Mexican and Central American fires
  - Saharan dust

Too little there… Many popular consumer products like air conditioners and refrigerators involve CFCs or halons during either manufacture or use. Over time, these chemicals damage the earth's protective ozone layer.



Too much here… Cars, trucks, power plants and factories all emit air pollution that forms ground-level ozone, a primary component of smog.

*Source: EPA's "Good Up High, Bad Nearby" publication

GHG Regulation History

- **May 2007:** US Supreme Court ruled that GHGs are air pollutants covered by the Clean Air Act
- **December 2009**: EPA issued "Endangerment Finding"
- **April 2010**: EPA issued tailpipe rule establishing GHG emission standards for light-duty vehicles
- **May 2010**: EPA issued "Tailoring Rule," requiring permitting for the largest GHG sources
- **April 2012**: EPA proposed GHG standards under the New Source Performance Standards for new power plants.
- **June 2013**: President Obama's Climate Action Plan
- **January 2014**: EPA re-proposed New Source Performance Standards for new power plants

President Obama’s Climate Action Plan

- Plan released in June 2013, consisting of three key pillars:

- **Cut carbon pollution in America - 17 percent below 2005 levels by 2020**
  - **Reduce power sector greenhouse gas emissions**
  - Accelerate clean energy leadership
  - Build a 21st century transportation sector
  - Cut energy waste in homes, businesses, factories
  - Reduce other greenhouse gas emissions (e.g., HFCs, methane)
- **Prepare the United States for climate change**
  - Support sustainability and climate resilience efforts
  - Maintain agricultural productivity
- **Lead international efforts to combat global climate change and prepare for its impacts**

- **Clean Power Plan finalized August 3, 2015**

Standards for New Plants

- Original NSPS proposal had emission limit of **1,000 lbs**. CO2/MWh
- EPA issued revised proposal for **new** units on September 2013
- Coal fired EGU standard **raised to 1,100 lb CO_2/MWh**..... would still require carbon capture
- Natural gas EGU standard from 1,000 to 1,100 lb CO_2/MWh depending on size of unit

Standards for Existing Plants

- CAA Section 111(d) contains authority for existing facilities
  - Rarely used section ….. EPA has used only five times
  - Based on same "standard of performance" language
- EPA issues guidance/standards to States
  - Best system of emission reduction
  - Emission limit(s)
  - Compliance horizon
- Schedule for EPA to issue standards
  - *June 2014* - Proposed standards/regulations due
  - *June 2015* - Final standards/regulations due
  - *June 2016* - States submit Emission Guideline Plans

Affordable Clean Energy Rule

- On August 18, 2018 the Trump administration moved to formally replace the Clean Power Plan, an environmental regulation that former President Barack Obama once lauded as the single-most important step America has ever taken to fight climate change.

- The long-anticipated proposal, called the Affordable Clean Energy Rule, would give individual states more authority to make their own plans for regulating greenhouse gas emissions from coal-fired power plants.

Affordable Clean Energy Rule

- The proposal will work to reduce GHG emissions through four main actions:
  - ACE defines the “best system of emission reduction” (BSER) for existing power plants as on-site, heat-rate efficiency improvements;
  - ACE provides states with a list of “candidate technologies” that can be used to establish standards of performance and be incorporated into their state plans;
  - ACE updates the New Source Review (NSR) permitting program to further encourage efficiency improvements at existing power plants; and
  - ACE aligns regulations under CAA section 111(d) to give states adequate time and flexibility to develop their state plans.
- The proposed ACE Rule is informed by more than 270,000 public comments that EPA received as part of its December 2017 Advance Notice of Proposed Rulemaking (ANPRM).

West Virginia v. Environmental Protection Agency

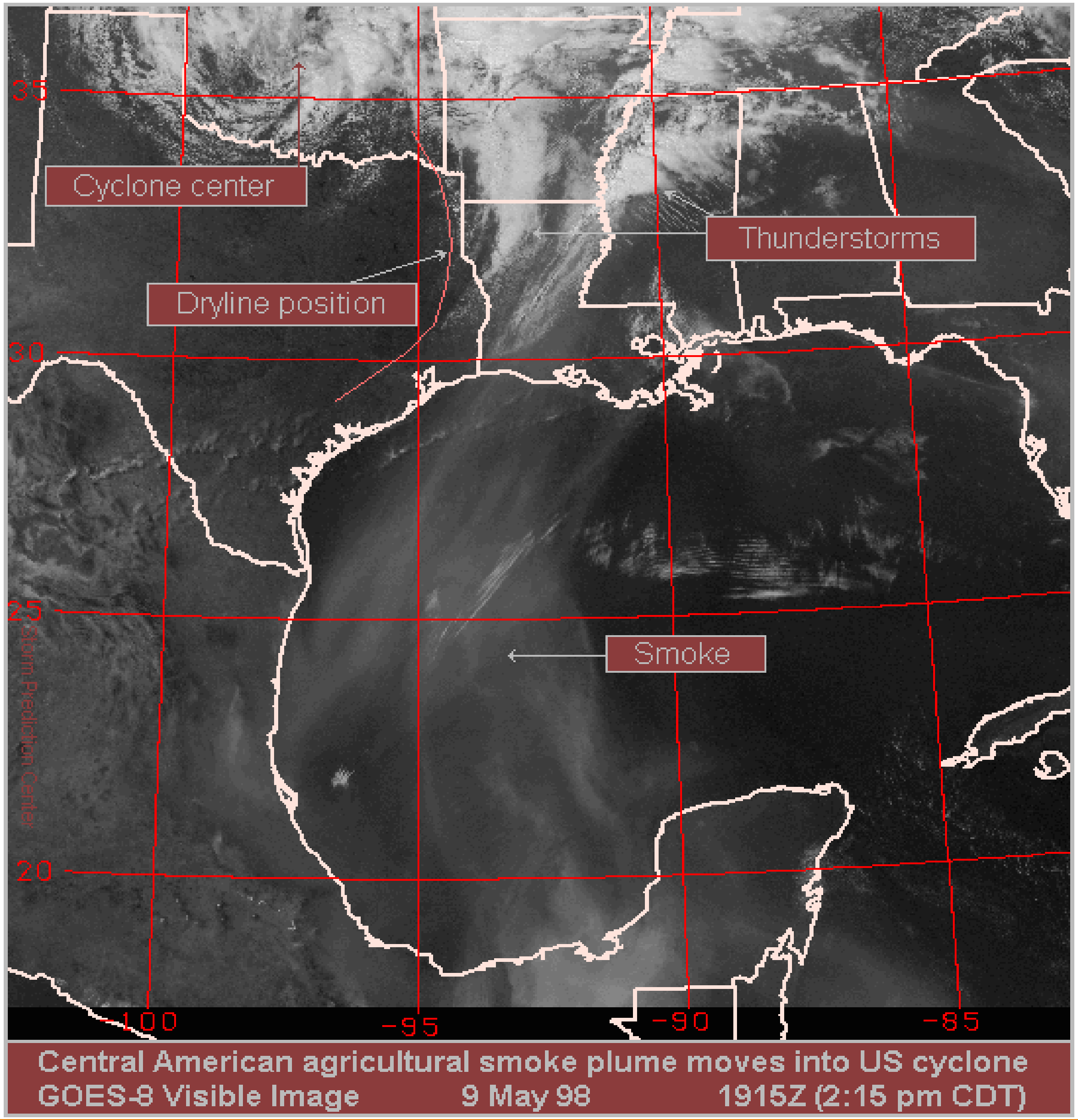
The conservative majority of the U.S. Supreme Court fenced the EPA's ability to regulate carbon emissions in the power sector.

In the June 30, 2022 6-3 decision, the court ruled that the Clean Power Plan established under the Barack Obama administration went beyond the EPA's regulatory mandate. Specifically, the EPA had exceeded congressional authority by pushing utilities to make system-wide moves away from coal power generation and toward cleaner forms of electricity production, such as wind and solar energy.

The EPA can take steps to function within its bounds. The agency retains the authority to implement power plant–specific regulations, such as heat rate improvements, co-firing with natural gas or wood chips, carbon capture, or some combination of these strategies, all of which can help to lower emissions.

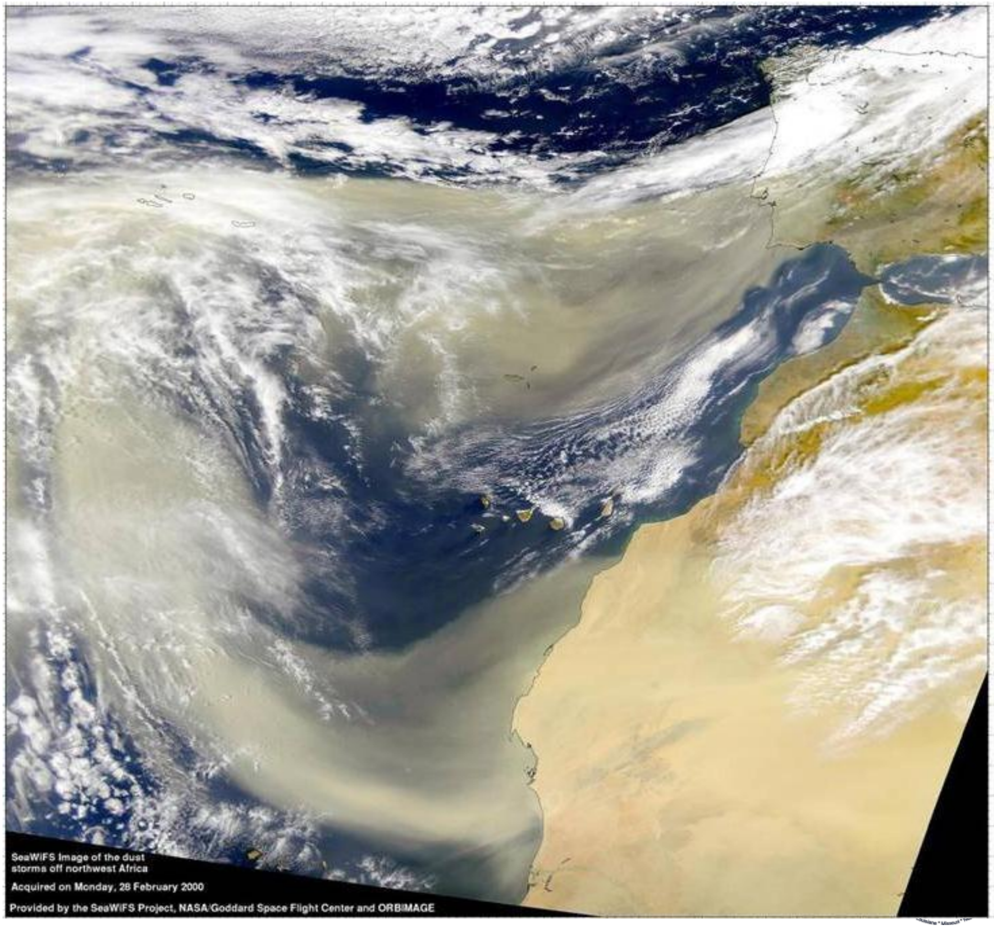
Mexican & Central American fires

- Primarily involves US and Mexico/Central American countries only, though Canada may see some effects
- Texas has demonstrated that smoke from the Mexican fires causes increases in Ozone concentrations in Texas nonattainment areas
- Smoke is also a factor in $PM_{2.5}$ and Regional Haze
- How to address these emissions over which neither CenSARA states nor EPA has authority


35
30
25
20
Cyclone center
Dryline position
Thunderstorms
Smoke
Storm Prediction Center
-100
-95
-90
-85
Central American agricultural smoke plume moves into US cyclone
GOES-8 Visible Image 9 May 98 1915Z (2:15 pm CDT)

Saharan dust

- Windstorms in the Sahara desert in northern Africa create massive dust storms
- Some of the dust reaches the continental US
- This is a naturally occurring phenomena, but it can affect air quality

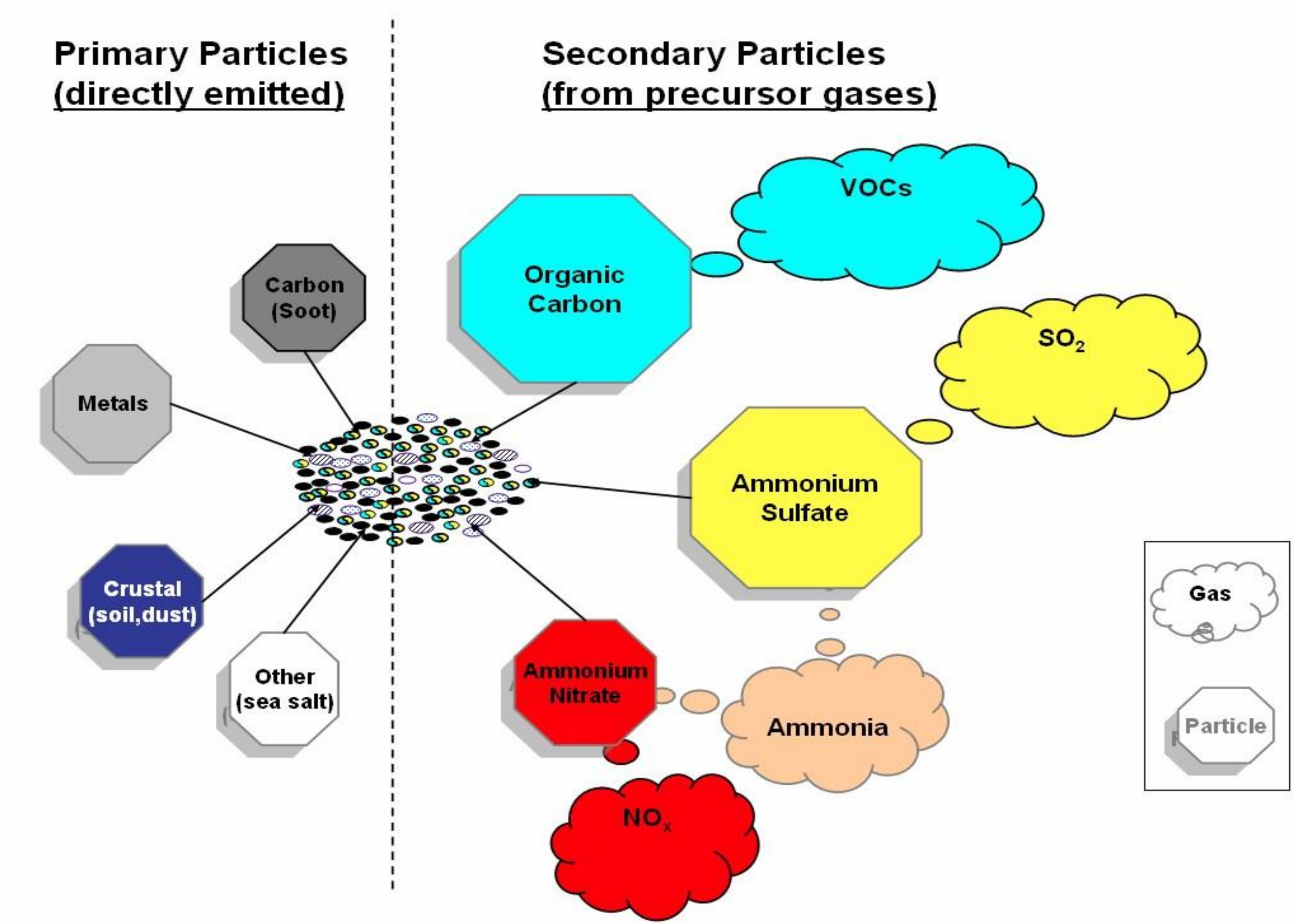


Pollutant Formation

Pollutant Formation Methods

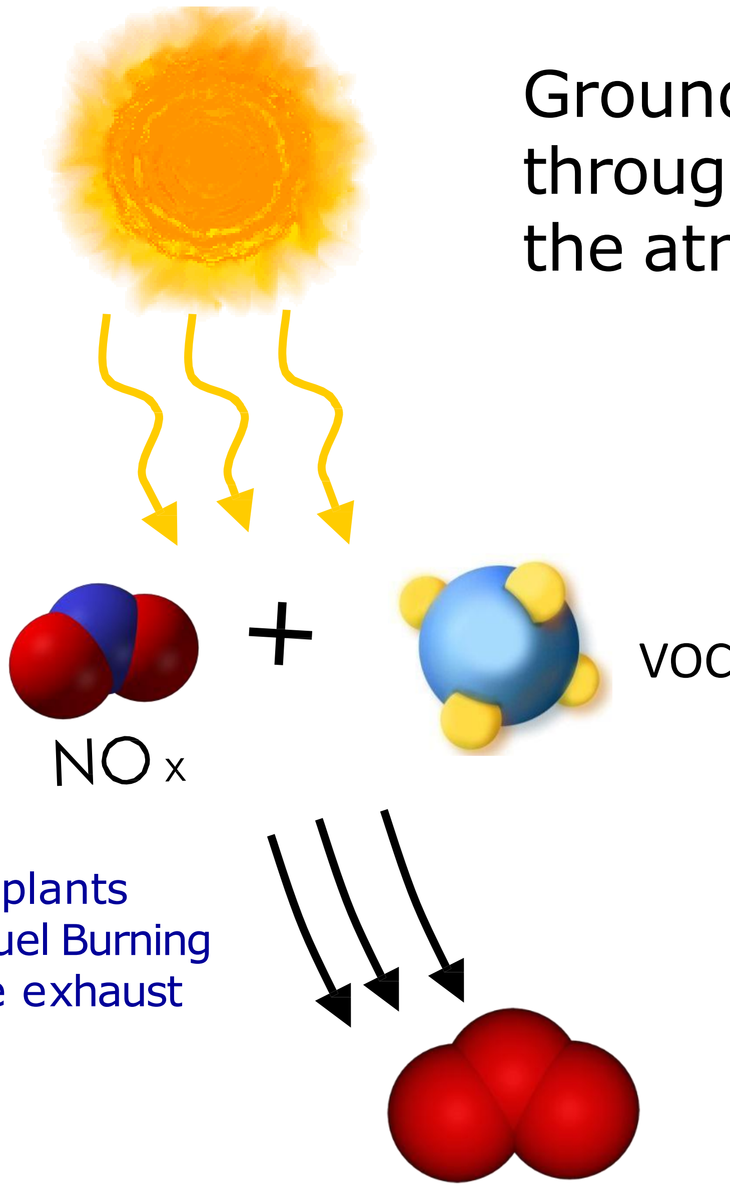
- Combustion
- Evaporation
- Physical attrition and mechanical dispersion
- Direct releases
- Natural emissions

- Some pollutants are emitted directly into the atmosphere
  - Referred to as "primary pollutants"
- Some pollutants form in the atmosphere due to chemical reactions
  - Referred to as a "secondary pollutants"



Primary Particles
(directly emitted)
Secondary Particles
(from precursor gases)
VOCs
Organic Carbon
Carbon (Soot)
SO_2
Metals
Ammonium Sulfate
Crustal (soil,dust)
Other (sea salt)
Gas
Ammonium Nitrate
Ammonia
Particle
NO_x

Ground level ozone is formed through chemical reactions in the atmosphere



- Fires
- Solvents
- Vegetation
- Vehicle
- Industrial Processes
- Vehicle Exhaust & Evaporation

- Power plants
- Fossil Fuel Burning
- Vehicle exhaust

Ozone (O_3)

(UV sunlight + Heat + NO_x + VOCs $\rightarrow$ O_3)

Combustion

- One of the primary sources of the pollutants we regulate is combustion
- Chemical reaction between hydrocarbon and oxygen which ideally results in water, CO_2 and heat
  - $CH_4 + 2\,O_2 \longrightarrow 2\,H_2O + CO_2 + \text{heat}$
  - HOWEVER:
  - The conditions of combustion are not always ideal
  - Fuels are contaminated
  - Air (which supplies oxygen in most combustion processes) is approximately 78% nitrogen
  - Combustion, as in life and this presentation, is not perfect

Combustion

- Three T's of combustion
  - Time – residence time
  - Temperature
  - Turbulence

- Generally, you maximize the three T's to insure complete combustion of the fuel
  - Also, get the maximum heat
  - Doesn't occur for many reasons
  - When it doesn't occur, various emissions go up
  - When it does occur, NO_x emissions go up

Combustion

Combustion

- Fuel
  - Hydrocarbon
  - Sulfur
  - Nitrogen
  - Metals
  - Cl
- Air
  - O_2
  - Nitrogen

→

Emissions

- H_2O
- CO_2
- CO
- NO_x
- SO_x
- Metals
- HC
- PM_{10} and $PM_{2.5}$
- Soot
- Dioxin/Furans

Pollutant Formation

- Evaporation
  - Primarily VOC emissions
  - What are VOCs?
  - Why are a whole lot of compounds that are not very volatile "VOCs"?
  - Why do we care about VOC emissions?
- Physical attrition and mechanical dispersion
  - Particulate matter formed when two surfaces rub together
    - Grinding/crushing/sawing type operations
    - E.g., rock crushers, saws, sanders, shapers, etc
  - Usually will be larger PM, though can include PM10

Pollutant Formation

- Direct releases
  - Methane releases from O&G exploration
  - CFC releases from air conditioning leaks and repairs
- Natural emissions
  - Biogenic
  - Wildfires
  - Geogenic
- These emissions need to be (and are) accounted for in air quality photochemical modeling and planning


Why are the Great Smoky Mountains smoky?

Review

NAAQS Review

- EPA has set NAAQS for 6 criteria pollutants
- States develop SIPs to assure attainment or compliance with the NAAQS
- Compliance status determined through ambient monitoring
- Three classifications – nonattainment, attainment, & unclassifiable
- Nonattainment areas – CAA Title I, Part D
  - Attainment plan
  - NA-NSR
    - LAER and Off-sets
  - TCMs
  - Conformity
  - After attaining standard, develop Maintenance Plan
- Attainment/unclassifiable areas – CAA Title I, Part C
  - PSD and Increment
- Minor NSR
- General SIP requirements

NSPS Review

- Section 111 of the CAA
- NSPS apply to source categories
- Applicability depends upon date of construction, modification or reconstruction
- Primarily address criteria pollutant emissions, a few other pollutants addressed
- Specifies an emissions rate, not a type of control
- NSPS are found at 40 CFR Part 60
- Most states have been delegated authority to enforce the NSPS

NESHAPs Review

- Section 112 of the CAA
- 40 CFR Part 61 – pre-1990 health based standards
- 40 CFR Part 63 – post-1990 technology based standards
  - 187 listed HAPs
  - Regulated by MACT standards
  - MACT standards are by source category
  - MACT standards for existing sources and new sources
  - MACT hammer if EPA fails to promulgate a MACT as scheduled

Acid Rain Review

- Title IV of CAA regulates NO_x and SO_x emissions from Affected Sources
- NO_x emissions regulated by “command and control”
- SO_x emissions regulated by “market based” “cap and trade” strategy
  - At end of year, must have at least one allowance for each ton of SO_x emissions
  - A source can over-control emissions and sell allowances like stock
  - States primary involvement is overseeing RATAs and integrating requirements into Title V permit

Stratospheric Ozone Review

- Title VI implements US obligations under the Montreal Protocol
- Purpose is to reduce depletion of ozone in the stratospheric ozone layer
  - Good up high, bad nearby
- Limits use, manufacture and importing of ozone depleting substances
- Title VI requirements are applicable requirements for purposes of Title V

Regional Haze Review

- The purpose of the Regional Haze program is to improve visibility in National Parks and Wildlife Areas
- RPOs developed to conduct technical work
  - CENRAP is the RPO for the CenSARA states
- States are to develop programs to reduce emissions of visibility impairing pollutants
  - 60 year program
  - No degradation on the best days
  - Improvement on the haziest days
- States also to conduct BART analysis and implementation

Title V Operating Permit Review

- Quick Review:
  - Combines all applicable requirements into one document
  - State programs are approved by EPA
    - 40 CFR Part 70 contains the requirements that state programs must meet
    - 40 CFR Part 71 is the federal Title V program
  - Some key concepts and phrases
    - Responsible official
    - Emissions fees
    - SBAP
    - Application shield
    - Permit shield
    - Affected states
    - FESOPs
    - CAM
    - Risk management plans

Almost There!

Login to www.censara.org

Complete Course Evaluation

Print the User Certificate

SOME MORE USEFUL INTERNET TOOLS

Useful Internet Tools

- EPA's Technical Air Pollution Resources website
  - https://www.epa.gov/technical-air-pollution-resources
- EPA's NSR Reform website
  - https://www.epa.gov/nsr
- Finding EPA publications
  - https://nepis.epa.gov/Exe/ZyNET.EXE?ZyActionL=Register&User=anonymous&Password=anonymous&Client=EPA&Init=1
- EPA's AIRNow website
  - http://www.airnow.gov/
- AAPCA website https://cleanairact.org/
- NACAA Website http://www.4cleanair.org/

Useful Internet Tools

- Find information relating to emission factors
  - https://www.epa.gov/chief

- Find information relating to BACT control technologies
  - https://www.epa.gov/catc

- Find information relating to MACT standards
  - https://www.epa.gov/stationary-sources-air-pollution/major-source-boiler-maximum-achievable-control-technology-mact

- Find information relating to the NCore monitoring program
  - https://www3.epa.gov/ttn/amtic/ncore.html#:~:text=NCore%20Multipollutant%20Monitoring%20Network&text=NCore%20is%20a%20multi%20pollutant,network%20on%20January%201%2C%202011.

- Find information relating to the IMPROVE monitoring network
  - http://vista.cira.colostate.edu/Improve/

Useful Internet Tools

- Find EPA interpretive letters for NSPS standards
  - http://cfpub.epa.gov/adi
- Find EPA guidance relating to routine maintenance under the PSD program
  - http://www.epa.gov/nsr/new-source-review-nsr-policy-and-guidance-database-search
- Find EPA guidance relating to the Title V program
  - http://www3.epa.gov/ttn/caaa/t5pgm.html
  - http://www.epa.gov/title-v-operating-permits
- Find EPA publication, "Ambient Monitoring Guidelines for Prevention of Significant Deterioration," EPA-450/4/87/007
  - http://www3.epa.gov/ttnamti1/archive/files/ambient/criteria/reldocs/4-87-007.pdf

Useful Internet Tools

- Why is the Regional Haze Program a 60 year program?
  - https://www.epa.gov/visibility
- Find information relating to how a petroleum refinery works
  - https://www.afpm.org/industries/operations/how-refineries-work
- What is the air quality forecast for your area?
  - http://www.airnow.gov/

Acronyms

Acronyms

- APC – Air Pollution Control
- AOS – Alternative Operating Scenario
- ARM – Approved Replicable Methodology
- AQCR – Air Quality Control Region
- BACT – Best Available Control Technology
- BAE – Baseline Actual Emissions
- BART – Best Available Retrofit Technology
- CAIR – Clean Air Interstate Rule
- CAA – Clean Air Act
- CAAA’90 – Clean Air Act Amendments of 1990
- CAM – Compliance Assurance Monitoring

Acronyms

- CEM – Continuous Emissions Monitor
- CFC – Chlorofluorocarbon
- CFR – Code of Federal Regulations
- CO_2e – Carbon Dioxide Equivalent
- COM – Continuous Opacity Monitor
- CPMS – Continuous Parametric Monitoring System
- CSAPR – Cross State Air Pollution Rule
- CTG – Control Techniques Guideline
- DOT – Department of Transportation
- EF – Emissions Factor
- EG – Emissions Guidelines
- EI – Emissions Inventory

Acronyms

- EPA – United State Environmental Protection Agency
- ESP – Electrostatic Precipitator
- EU – Emissions Unit
- FAP – Flexible Air Permit
- FESOP - Federally Enforceable State Operating Permits
- FGD – Flue Gas Desulfurization
- FGR – Flue Gas Recirculation
- FIP – Federal Implementation Plan
- FLM – Federal Land Manager
- FR – Federal Register
- FRM – Federal Reference Method
- GACT – Generally Available Control Technology

Acronyms

- HAPs – Hazardous Air Pollutants
- HVLP – High Volume Low Pressure
- I & M – Inspection and Maintenance
- LAER – Lowest Achievable Emission Rate
- LDAR – Leak Detection and Repair
- MACT – Maximum Achievable Control Technology
- MMBtu – Millions of British Thermal Units
- MPO – Metropolitan Planning Organization
- NA – Nonattainment
- NA-NSR – Nonattainment New Source Review
- NAAQS – National Ambient Air Quality Standards
- NEI – National Emissions Inventory
- NETI – National Environmental Training Institute

Acronyms

- NESHAP – National Emissions Standards for Hazardous Air Pollutants
- NMOC – Non-Methane Organic Compounds
- NOx – Oxides of Nitrogen
- NSPS – New Source Performance Standard
- NSR – New Source Review
- O & G – Oil and Gas
- O & M – Operation and Maintenance
- O/O – Owner or Operator PAE– Projected Actual Emissions
- PEMS -Predictive Emissions Monitoring System
- ppm – Parts Per Million
- ppb – Parts Per Billion
- PM – Particulate Matter
- PM10 – PM w/ aerodynamic diameter <10 microns
- PM2.5 – PM w/ aerodynamic diameter <2.5 microns

Acronyms

- PSD – Prevention of Significant Deterioration
- PTE - Potential to Emit
- RACT – Reasonably Available Control Technology
- RATA – Relative Accuracy Test Audit
- RFG – Reformulated Gasoline
- RFP – Reasonable Further Progress
- RMP – Risk Management Plan
- RMRR – Routine Maintenance, Repair and Replacement
- RPO – Regional Planning Organization
- RTO – Regenerative Thermal Oxidizer
- RVP – Reid Vapor Pressure

Acronyms

- SBAP – Small Business Assistance Program
- SCF – Standard Cubic Feet
- SCR – Selective Catalytic Reduction
- SIC – Standard Industrial Classification
- SIL – Significant Impact Levels
- SIP – State Implementation Plan
- SMC – Significant Monitoring Concentration
- SOx – Sulfur Oxides
- SSM – Startup, Shutdown and Malfunction
- T/yr or tpy – Tons per year
- TCM – Transportation Control Measures
- TEOM – Tapered Element Oscillating Microbalance PM monitor

Acronyms

- TIP – Tribal Implementation Plan
- TSP – Total Suspended Particulate
- TTN – EPA's Technology Transfer Network
- VMT – Vehicle Miles Traveled
- VOC – Volatile Organic Compounds

EXAM!!!!!

Make sure you take the Correct Final Exam

TCEQ : https://www.surveymonkey.com/r/XSHFMFQ

LDEQ: https://www.surveymonkey.com/r/XWKMQXF

ODEQ: https://www.surveymonkey.com/r/XRY55YN

Monitoring Homework Assignment

Visit EPA Appendix D – Network Design

For specific monitor placement requirements, select a pollutant and review the siting requirements. You will need to use Census information for population as well as Metropolitan or Combined Statistical Areas (MSA/CBSA) and the population data for your state.

Census Map
https://www2.census.gov/geo/maps/metroarea/us_wall/Feb2013/cbsa_us_0213.pdf

County Data – go here: https://www.census.gov/data/datasets/time-series/demo/popest/2010s-counties-total.html. Under "Annual Estimates of the Resident Population for Counties: April 1, 2010 to July 1, 2019" select your state and download the excel file.

Monitoring Homework

So pick your favorite criteria pollutant and come up with a monitoring plan for your state, identifying the **minimum** number of monitors you need (statewide) for your pollutant. Links to state monitoring network resources including maps and tables of current sites:

LA - https://www.deq.louisiana.gov/page/air-monitoring-sites

TX - https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=ab6f85198bda483a997a6956a8486539

OK - https://www.deq.ok.gov/air-quality-division/ambient-monitoring/current-air-quality-forecasts/

You can go into detail about actual locations for monitor placement (I would not go below MSA delineations) and we will talk about what everyone comes up with as a MINIMUM required number.

SIP Homework

For your state, evaluate the current status of your state's SIP based upon information contained on your agency's website (without bothering the SIP Manager). Here is a federal resource that you might use: https://www.epa.gov/air-quality-implementation-plans

- Can you determine the causes for and specific SIP backlogs that exist for your state?
- What SIPS are pending EPA approval?
- What are the greatest SIP challenges that you see for your state over the next 3 years?

- Be prepared for discussions tomorrow.

Pollutant Formation Homework

- If you wanted to reduce SO_x emissions, what 2 source categories would you initially evaluate?
- If you wanted to reduce NOx emissions, what 2 source categories would you initially evaluate?
- If you wanted to reduce VOC emissions, what 2 source categories would you initially evaluate?
- If you wanted to reduce CO2 emissions, what 2 source categories would you initially evaluate?