LADCO | LAKE MICHIGAN AIR DIRECTORS CONSORTIUM

Chicago Air Quality Update and Planning Opportunities

Presented to the MMC Environment Committee

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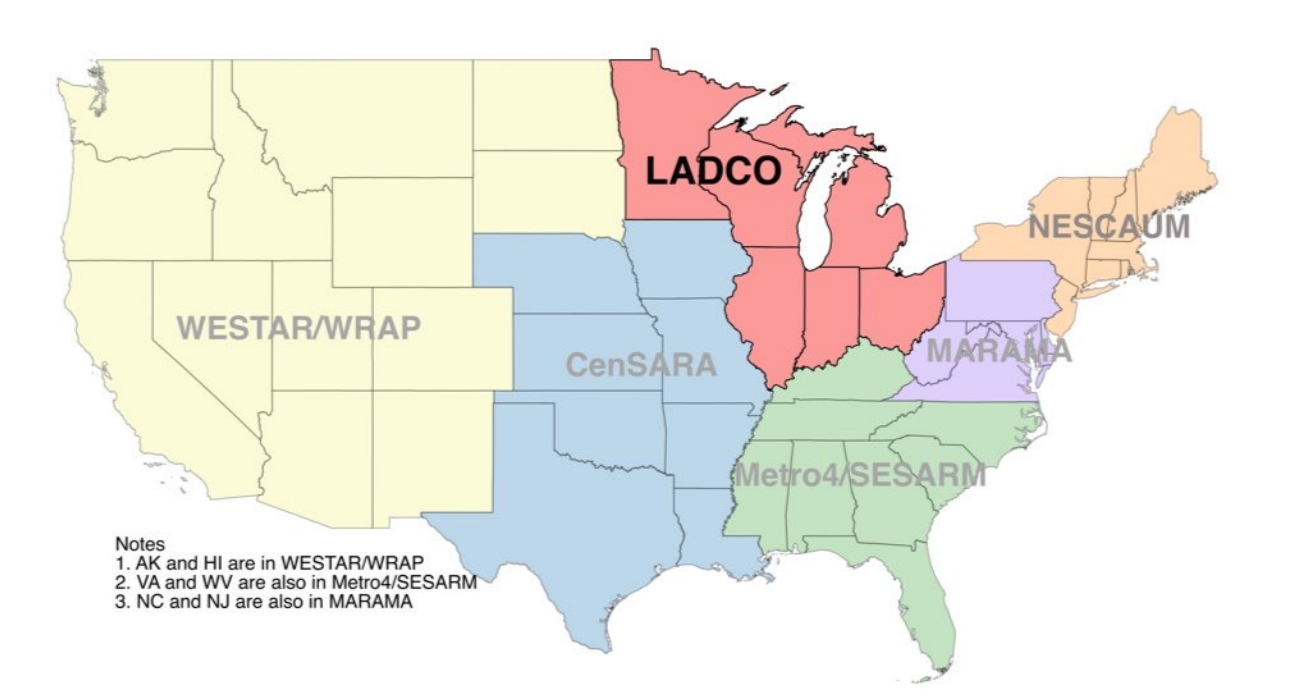
March 19, 2024

Presentation Topics

- Air pollution trends in the Great Lakes region and Chicagoland
- Air quality regulatory update
- Air pollution emissions trends and important sources in Chicago
- Air pollution management and the role of municipalities

What is LADCO?

Lake Michigan Air Directors Consortium



LADCO is funded primarily by U.S. EPA grants to the states under Section 105 of the Clean Air Act.

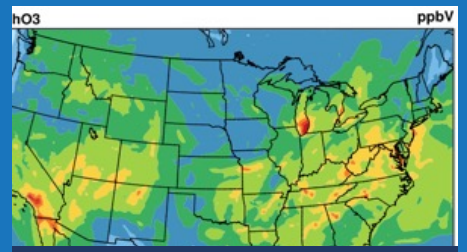
- Formed in 1989 to bring Michigan, Indiana, Illinois, and Wisconsin together to address ozone (O_3) pollution (aka smog)
  - Ohio joined in 2004; Minnesota joined in 2012
- Governed by state air agency directors
- Scope
  - Forum for state agency planners
  - Air pollution modeling and data science
  - Training

LADCO does not provide policy guidance to our membership, only technical guidance and support

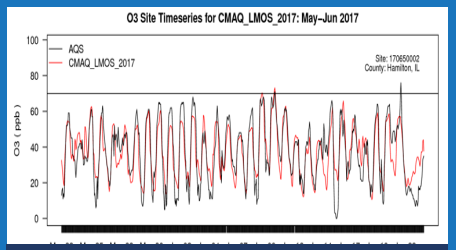
What Does LADCO Actually Do?

- Air Quality Modeling
- Data Science
- Air Quality Research
- Training Coordination
- Communication Platform
- Contract Management
- Outreach and Advocacy

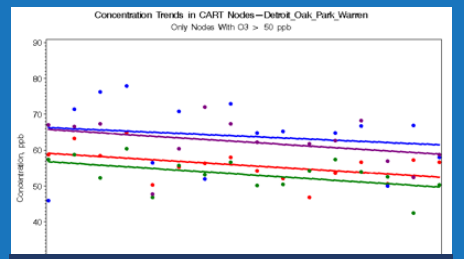
GIS & Mapping



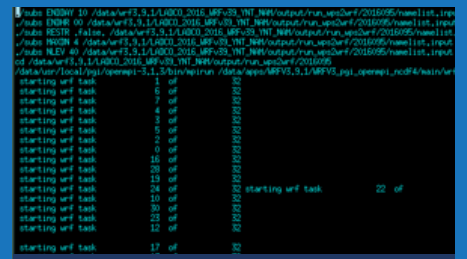
Modeling



Model Evaluation



Statistical Analysis



Cloud Computing

Technology Transfer

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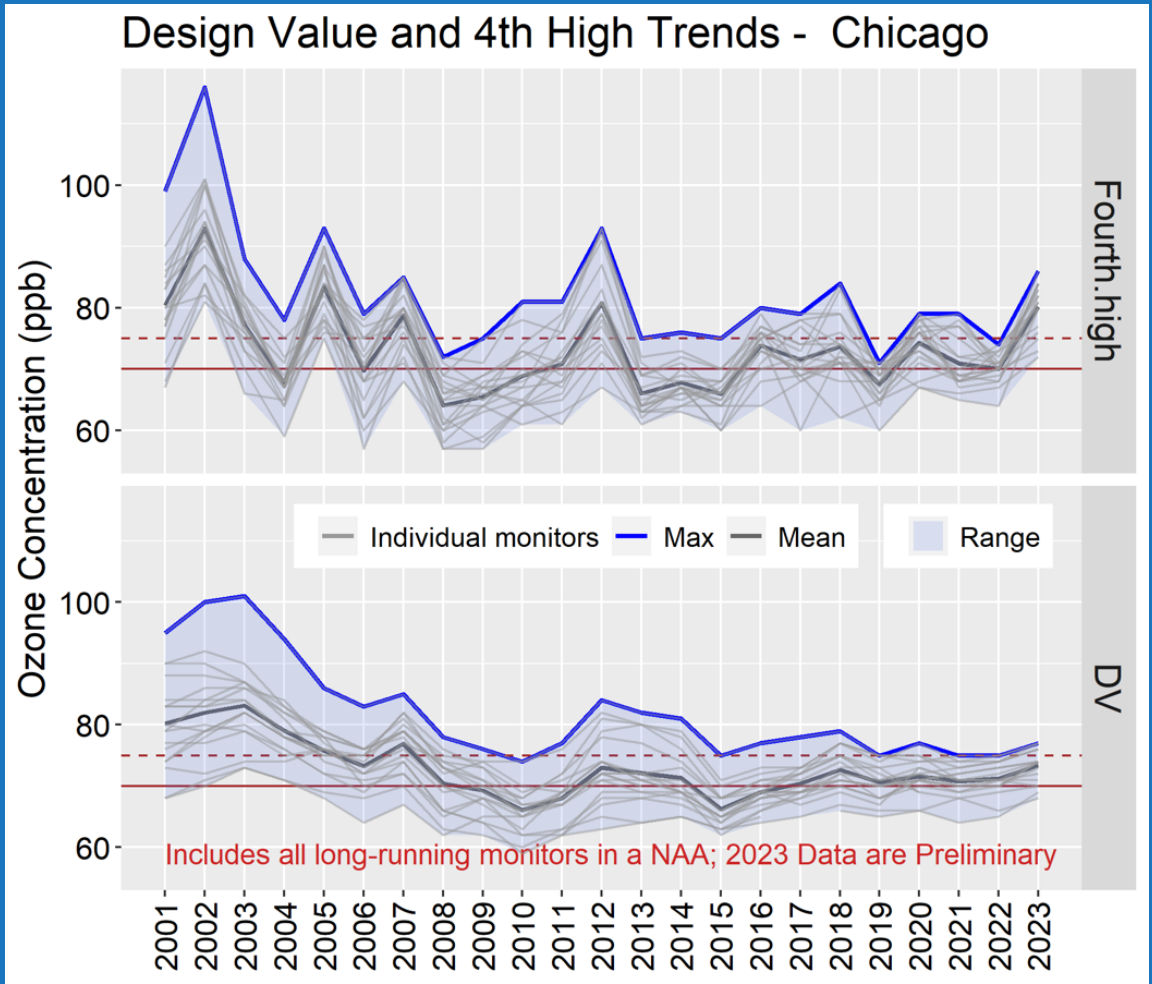
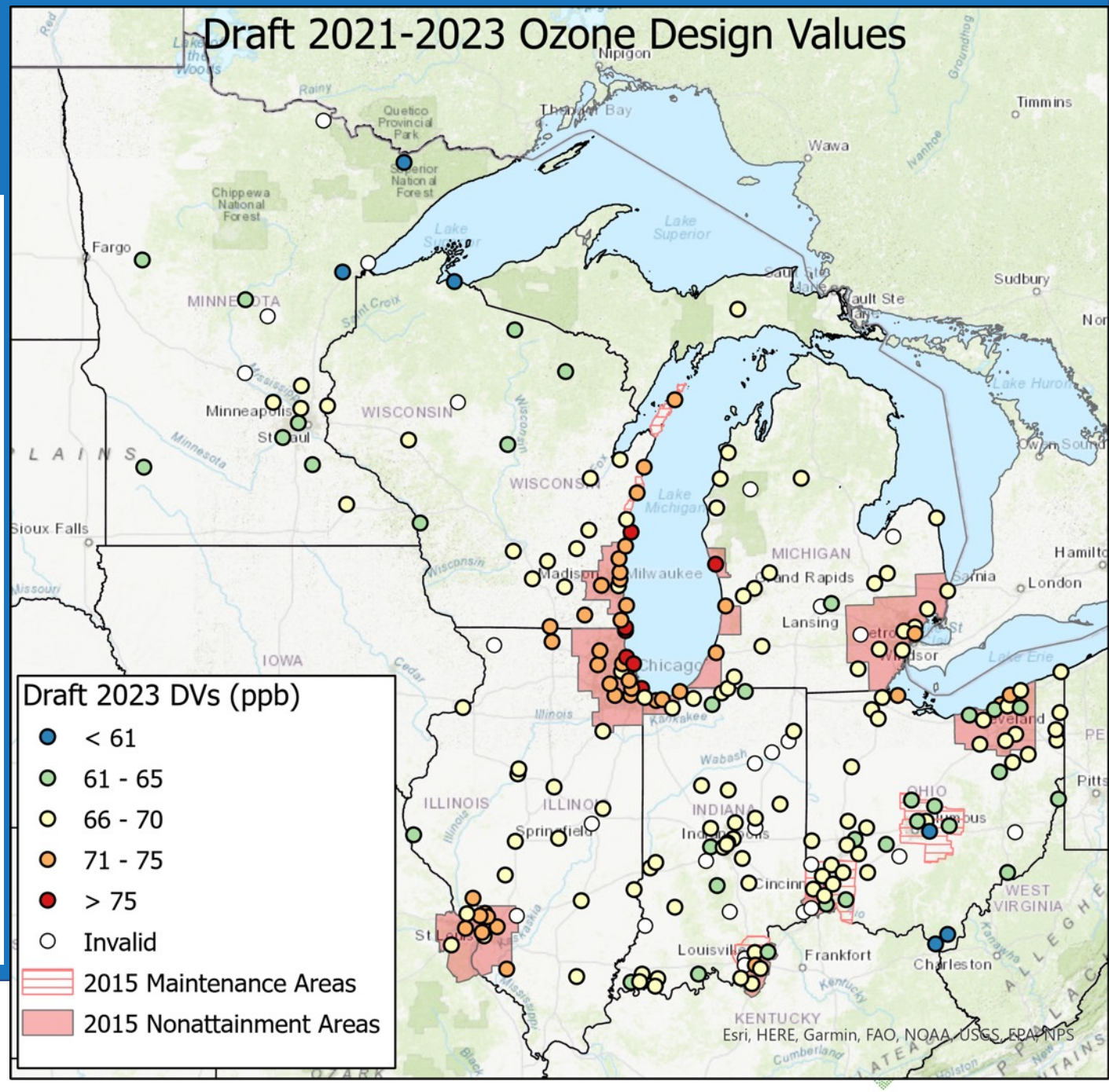
Air Pollution Trends

Air Pollution in Chicago

Pollutant	Season	Scale	Health Effects	Sources
Ozone (smog)	Summer	Regional	Respiratory	Combustion, fuels and solvents, vegetation
Particulate Matter (PM)	Winter & Summer	Regional and Local	Respiratory, cognitive	Combustion, fuels and solvents, vegetation, dust, fires, agriculture
Air Toxics	None	Local	Carcinogenic, mutagenic, respiratory	Solvents, surface coatings, personal care products, combustion
Nitrogen Oxides (NOx)	None	Local	Respiratory	Combustion

Ozone





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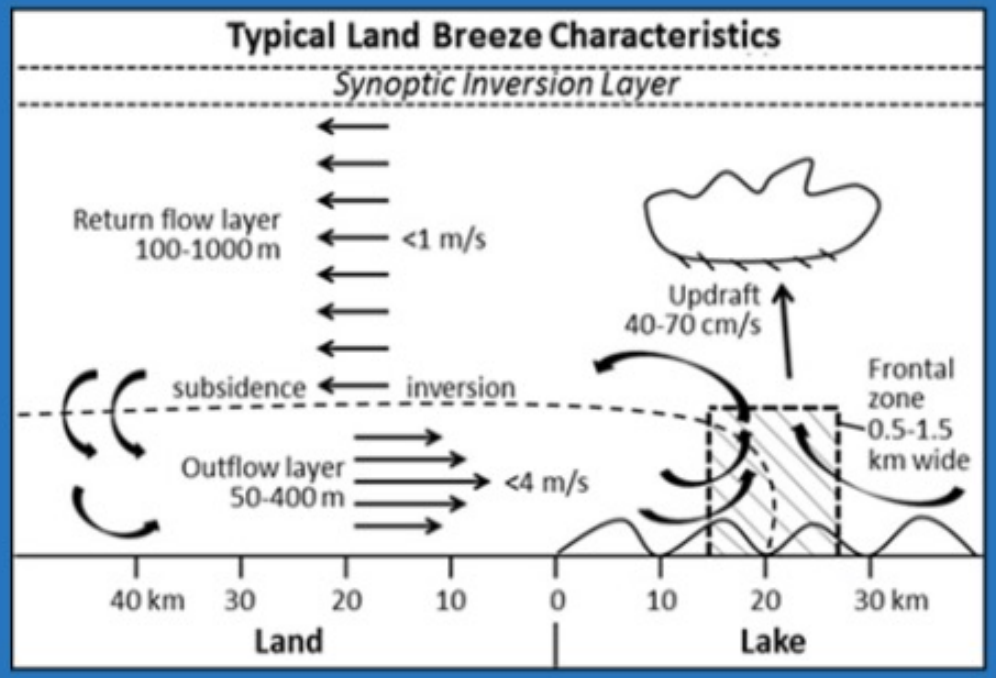
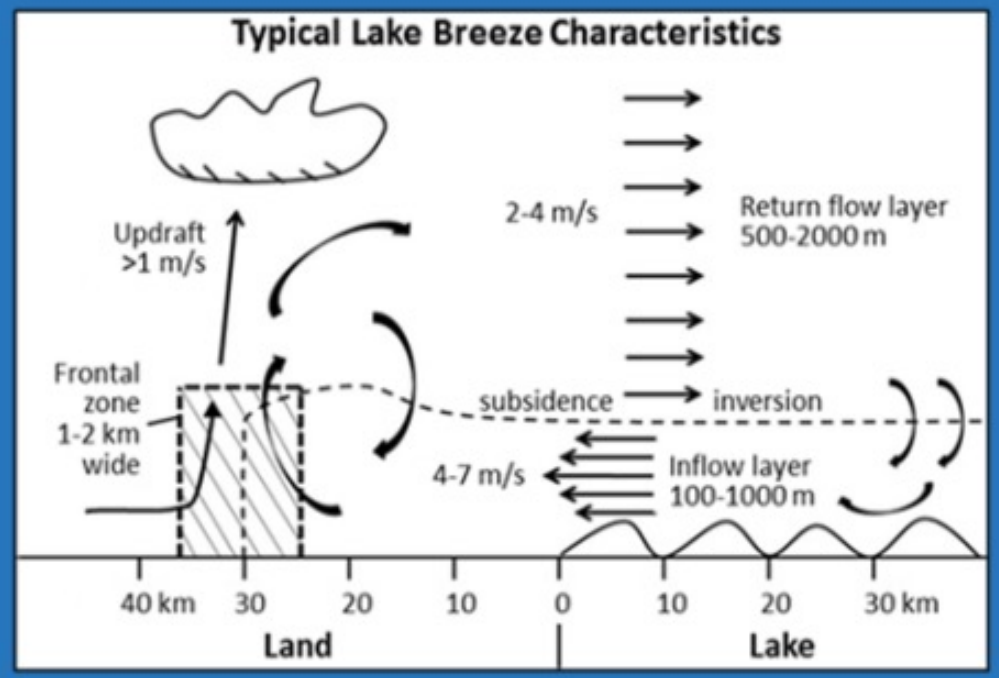
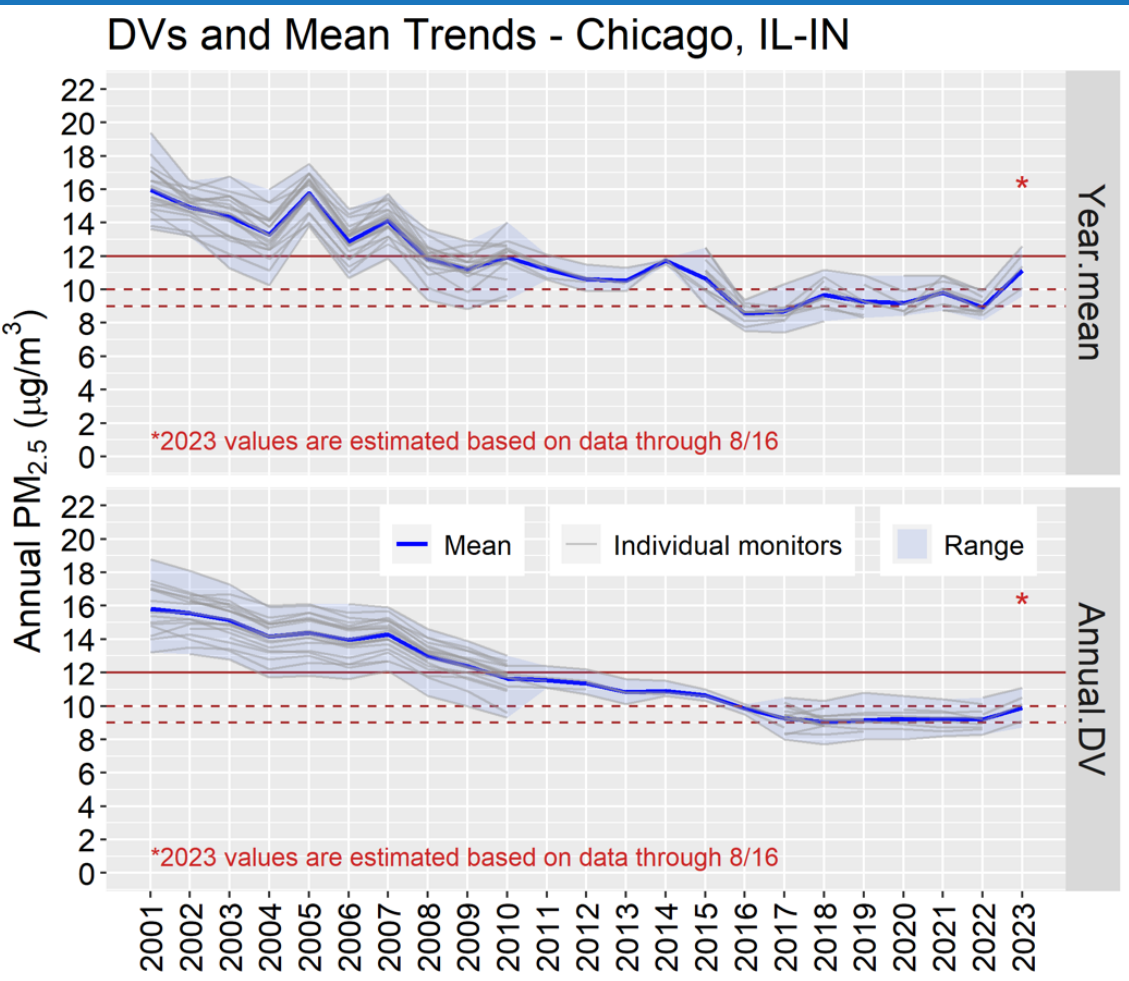
Q: Why Are Ozone Concentrations Highest Near the Lakeshore?

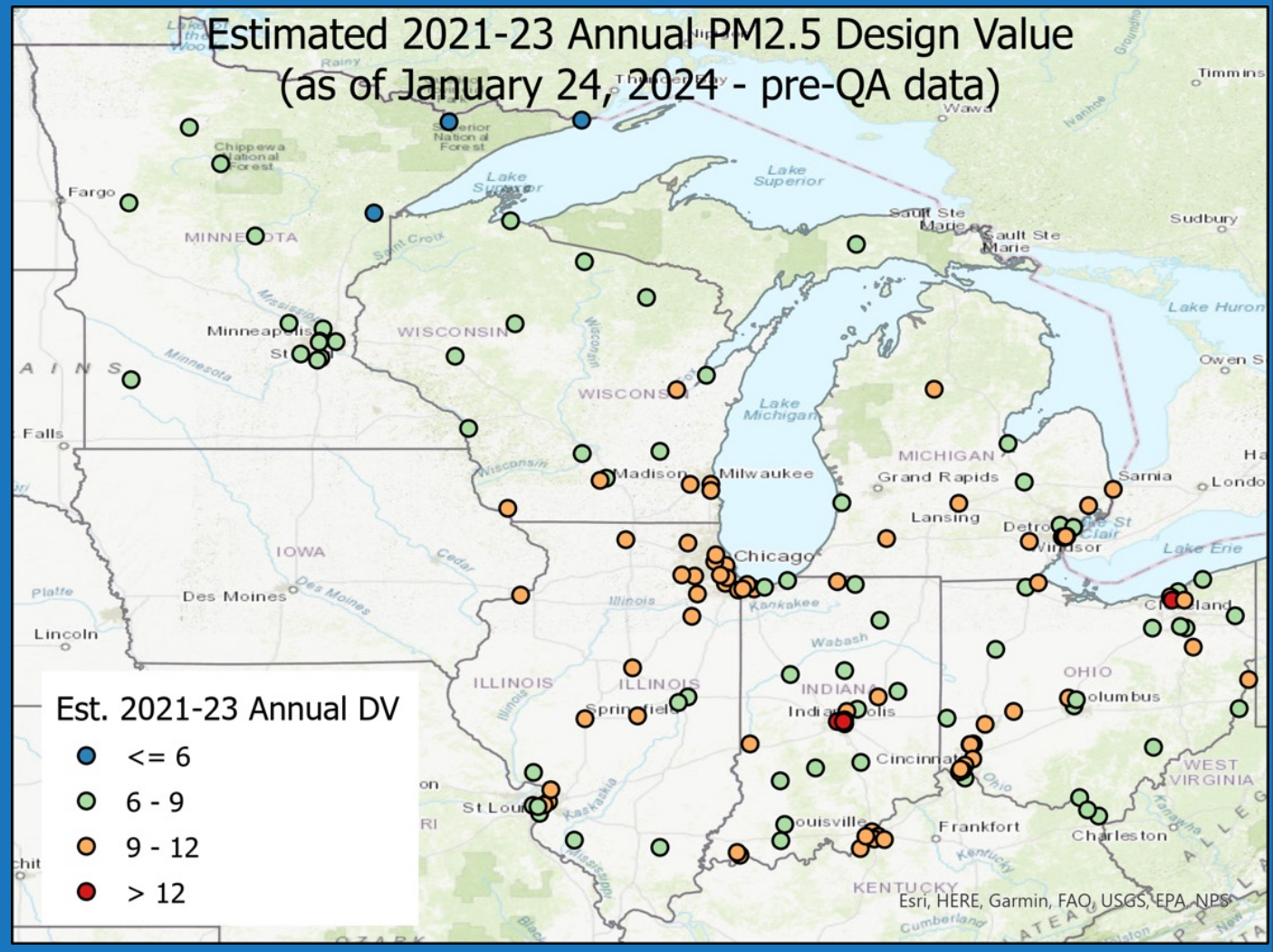




Emissions from Chicago and Northwest Indiana concentrate over the shallow over-lake atmosphere overnight and in the morning and the afternoon lake->land breeze brings high pollution air masses on shore

Fine Particulate Matter





New PM2.5 National Ambient Air Quality was promulgated on February 7, 2024 = **9 µg/m³**

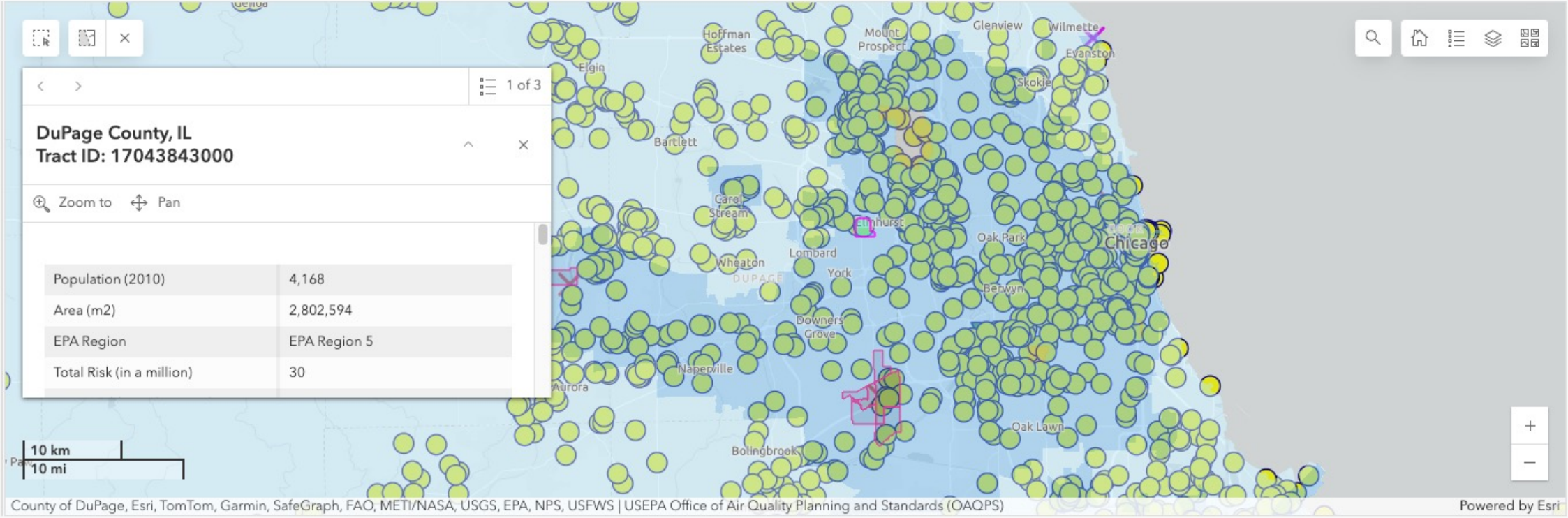
AirToxScreen

https://www.epa.gov/AirToxScreen

2019 Cancer Risk | 2018 Cancer Risk | 2017 Cancer Risk | 2019 Noncancer Hazards

AirToxScreen Mapping Tool (based on 2019 emissions)

Zoom to State(s)	Zoom to County(s)	Select Minimum Risk to Include	Select Only Tracts With Chan…
None	None	No number selected	None



Legend

in the tract for more info)

Cancer Risk (2019)

Total Risk (in a million)

- > 100 - 400
- > 75 - 100
- > 50 - 75
- > 25 - 50
- 5 - 25
- Zero Population Tracts

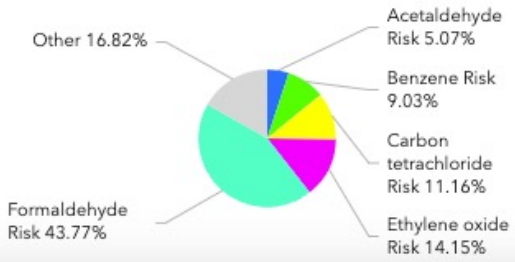
Tract Source Contribution

Search...

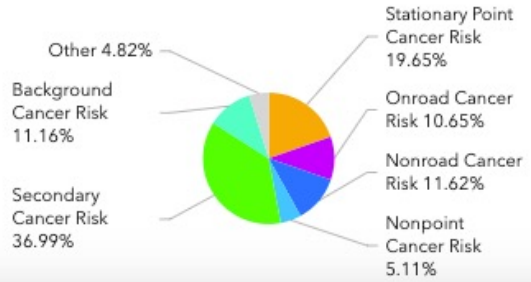
State: IL
County/Parish: DuPage County
Tract ID: 17043843000
Total Risk (per million): 30

Location | Air Toxic | Source

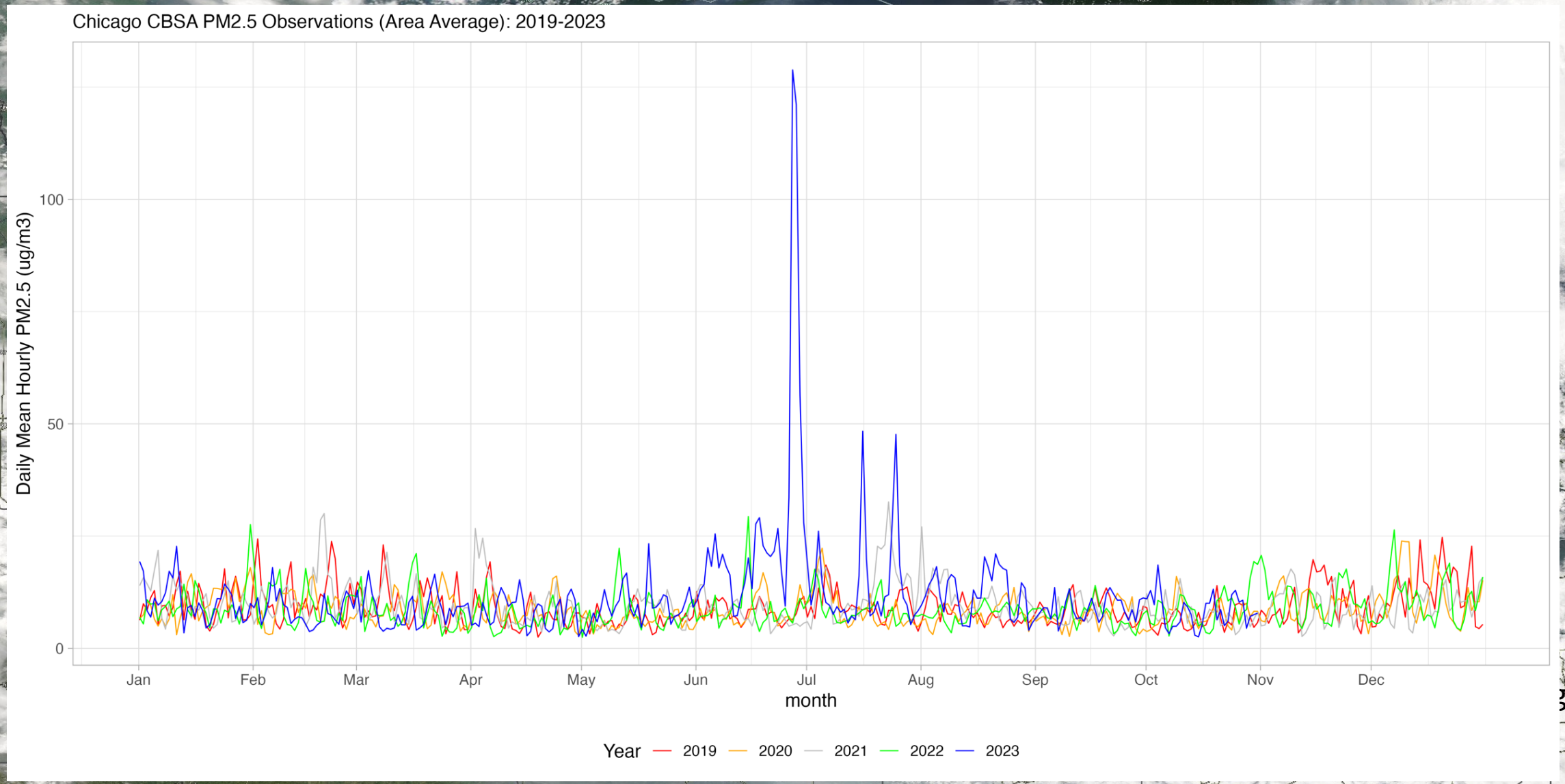
Risk by Air Toxic



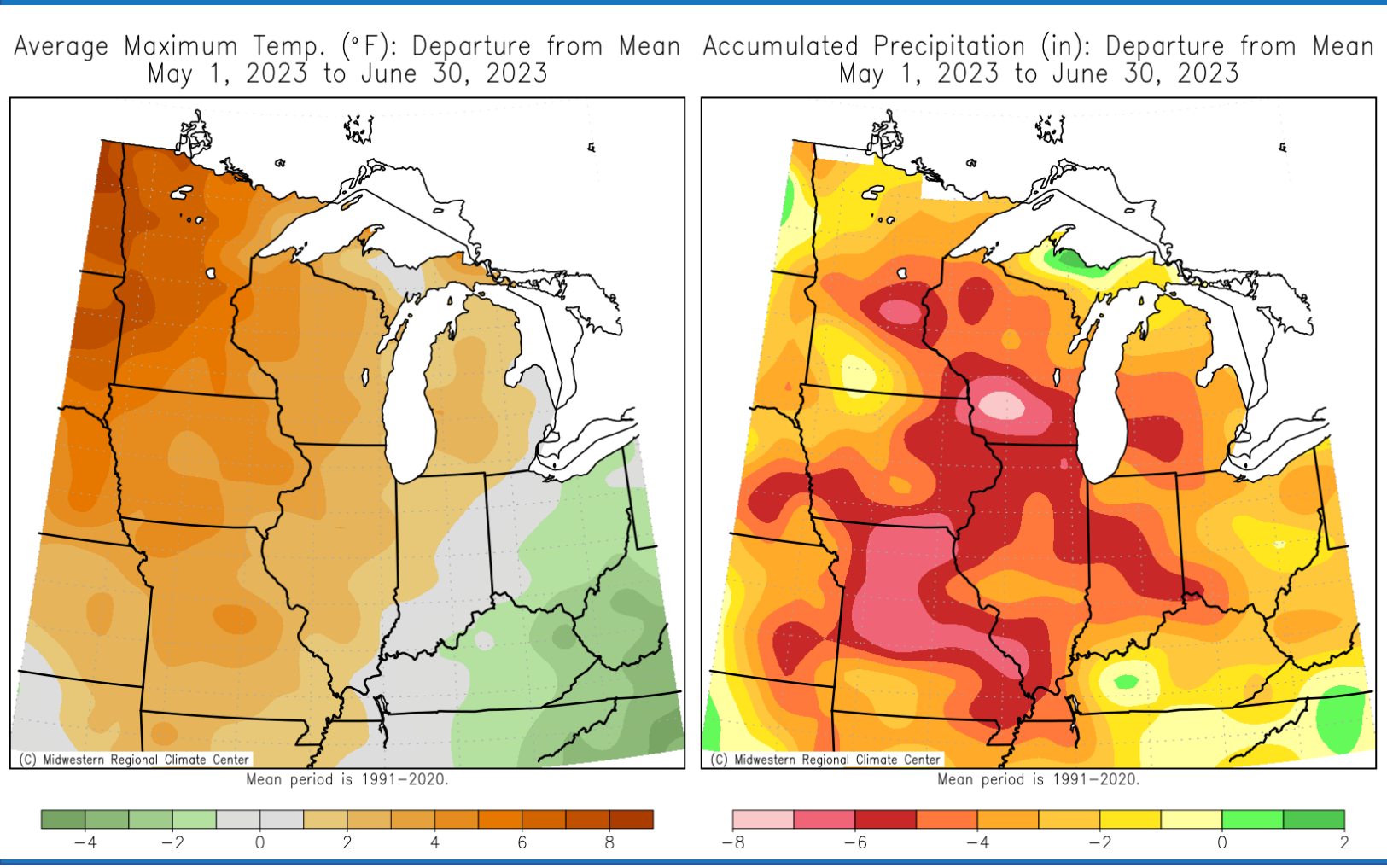
Risk by Source Type



The Story of 2023: Wildfire Smoke

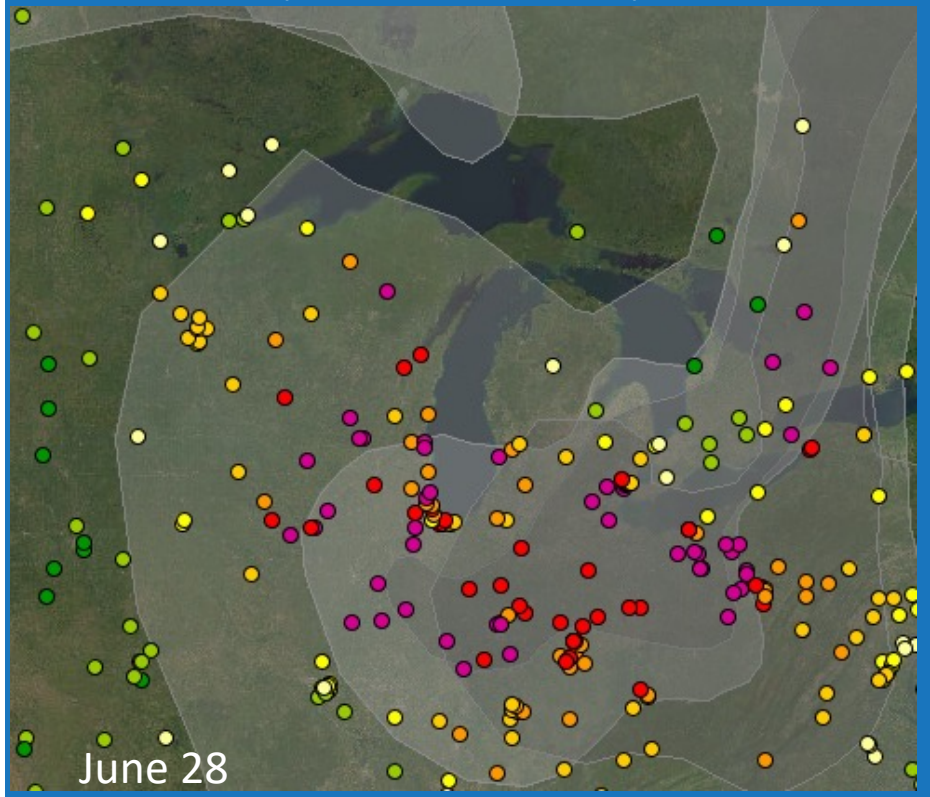


2023 Was Not Normal!!!



+ Smoke

(with VOCs & NOx)



May through June: Long period of hot temperatures, stagnation and no rain in the western part of the region → pollution built up

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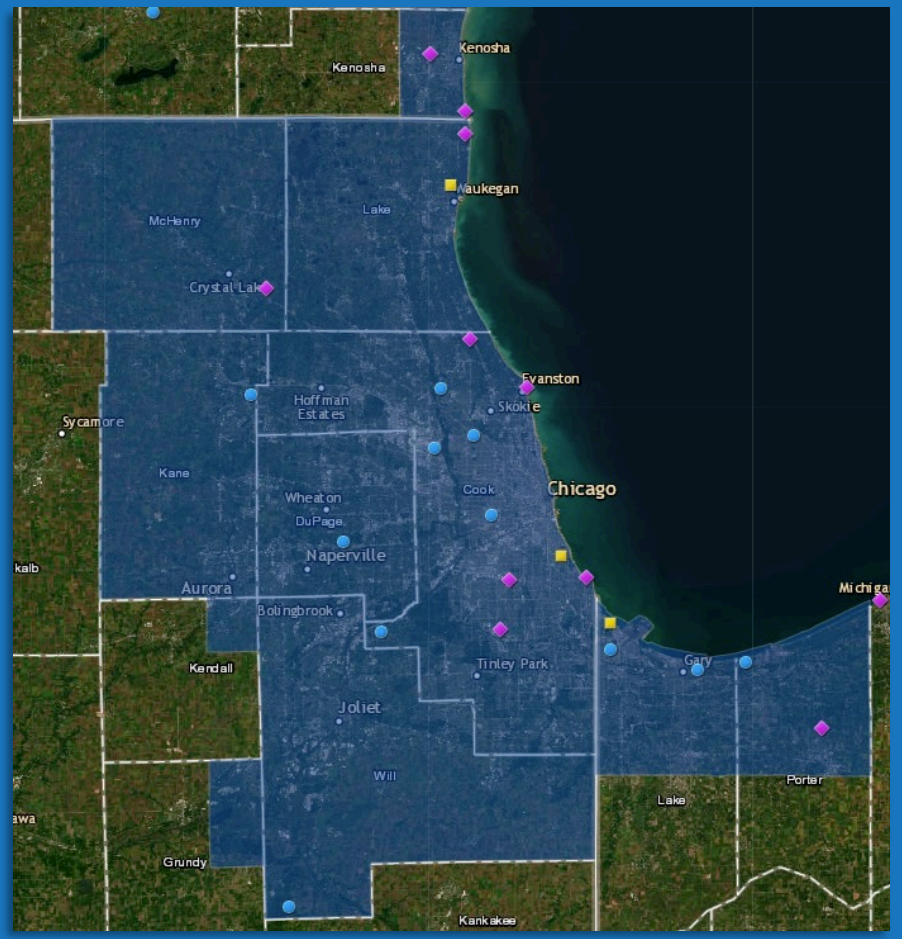
Air Quality Regulatory Update

Air Quality Issues In Chicagoland

- National Ambient Air Quality Standards (NAAQS)
  - Clean Air Act regulations that set limits for 6 “criteria” pollutants
  - Areas are determined to be meeting the NAAQS based on surface monitoring
- Chicago NAAQS History
  - Currently a non-attainment area (NAA) for ground-level ozone
  - Previously NAA for lead and particulate matter (PM)
- Chicago NAAQS Future
  - NAAQS are evaluated every 5 years, and they change
  - A new (lower) PM NAAQS has been promulgated that will result in Chicago being designated “nonattainment” for PM2.5



2015 Ozone NAAQS Chicago IL/IN/WI NAA

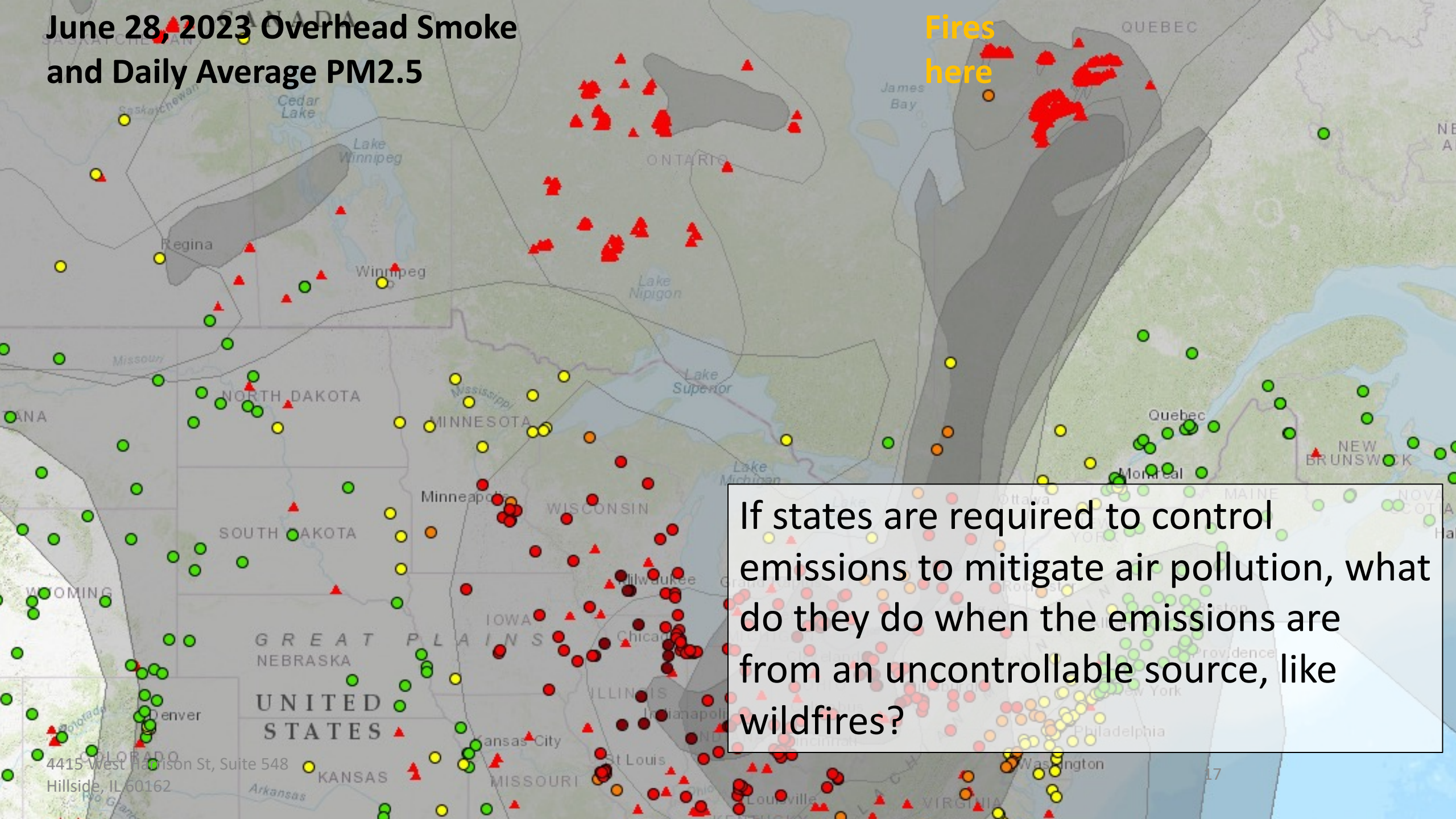
Ozone NAAQS Nonattainment Implications

- Regulatory requirements are progressive with time
  - Stationary sources (industrial and power “stacks”) have increasingly stringent control requirements; new source permitting becomes more difficult
  - Inspection/Maintenance (I/M) programs for on-road vehicles
  - State Implementation Plan (SIPs) with emissions control programs to reach attainment
- Chicago NAA (11 counties) will be “bumped up” to *serious* status in August 2024
  - Chicago was a serious NAA for an earlier ozone standard and all the requirements remain in place, e.g., vehicle I/M, major source permitting threshold @ 50 tons/year, etc.

PM2.5 NAAQS Nonattainment Implications

- New annual standard promulgated in February 2024
  - Weighted 3-year average = 9 µg/m^3
- US EPA will designate nonattainment areas based on 2022-2024 monitoring data
  - States to make recommendations to US EPA in February 2025
  - The current estimate of the annual $PM_{2.5}$ design value for Chicago is 11 µg/m^3

June 28, 2023 Overhead Smoke and Daily Average PM2.5



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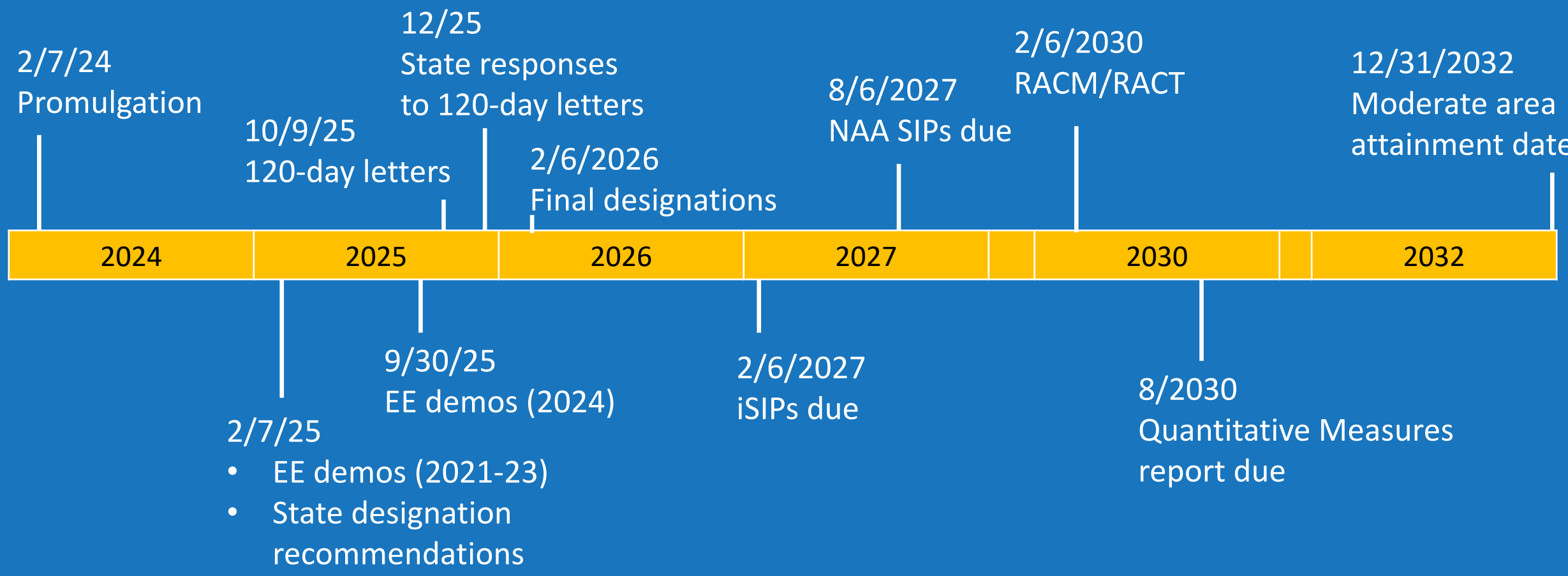
Exceptional Events

- The Exceptional Events Rule of 2007 codified 30 years of EPA guidance
- Allows air agencies to exclude air pollution episode data from design value calculations if
  - There exists a *clear and causal* relationship to the monitored violation
  - The event was *not reasonably controllable* or preventable
  - The event was caused by a human activity that is unlikely to recur at a particular location or it was a natural event

Events Covered by the EE Rule

… and prescribed fires, structure fires, fireworks, industrial accidents, natural disasters, terrorist attacks, earthquakes, stratospheric intrusion

Annual $PM_{2.5}$ NAAQS Planning Timeline



Ozone Transport and the “Good Neighbor” FIP

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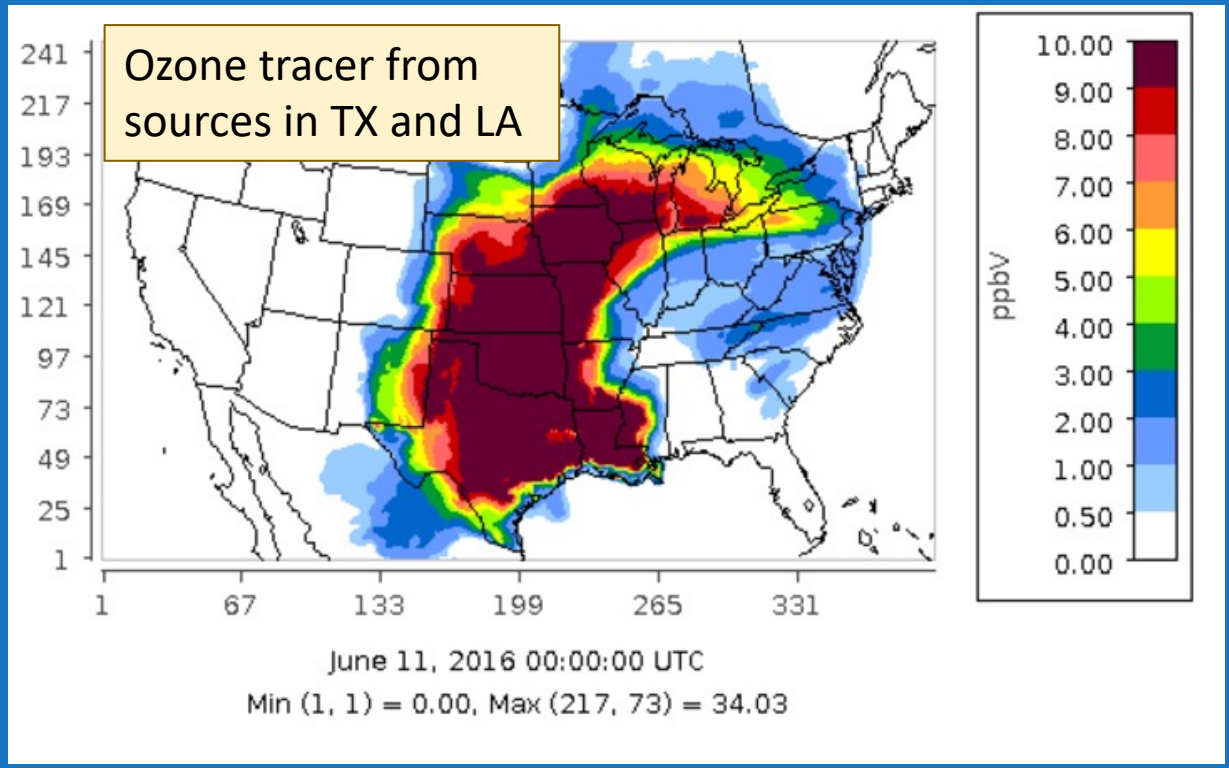
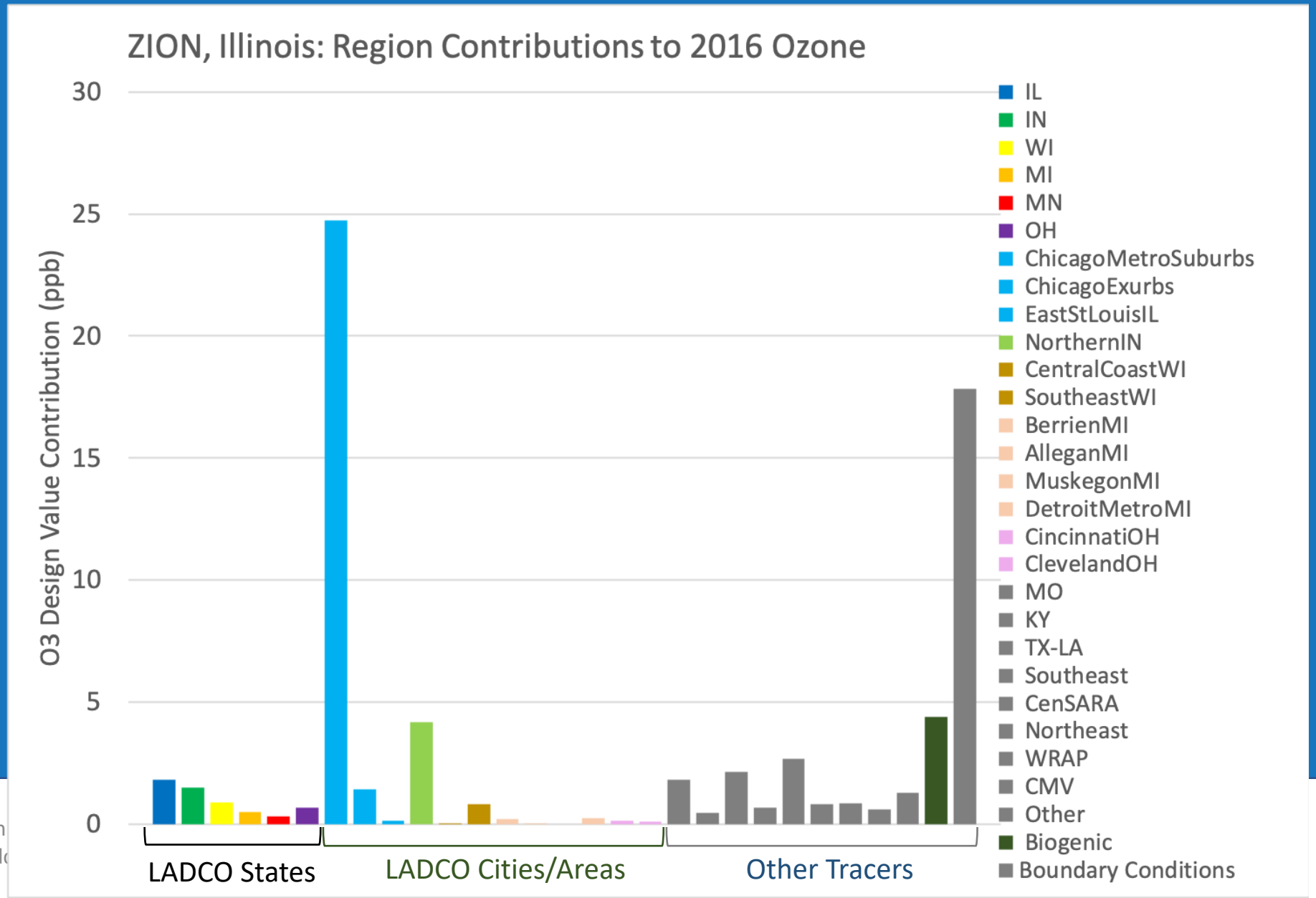
Ozone Transport

- Ozone and precursors can travel long distances (>1,000 km) to impact downwind receptors
- Identifying the sources of ozone is key to control strategies
- Modeling is used to trace ozone source-receptor relationships



LADCO Ozone Tracer Modeling: Regions



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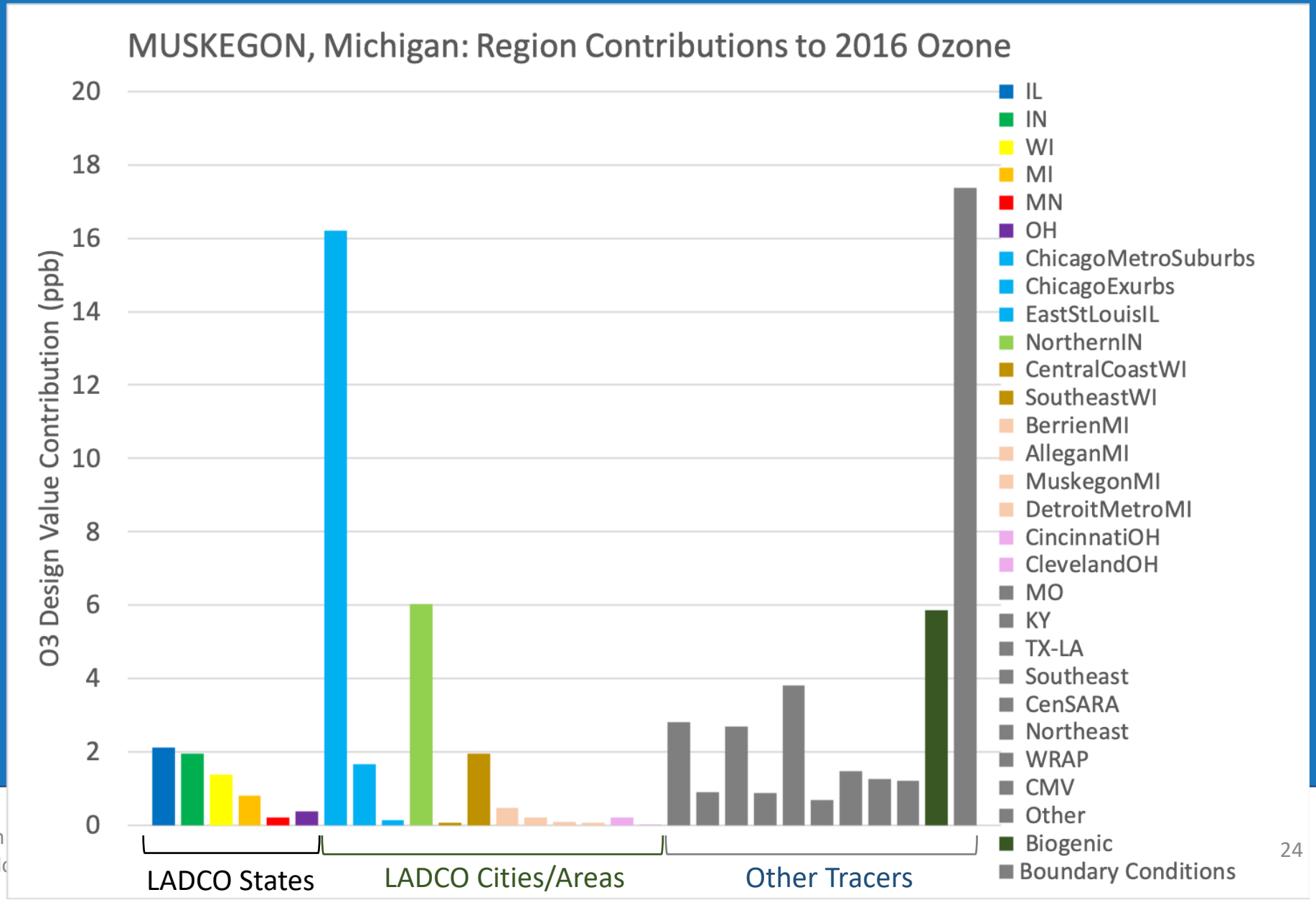
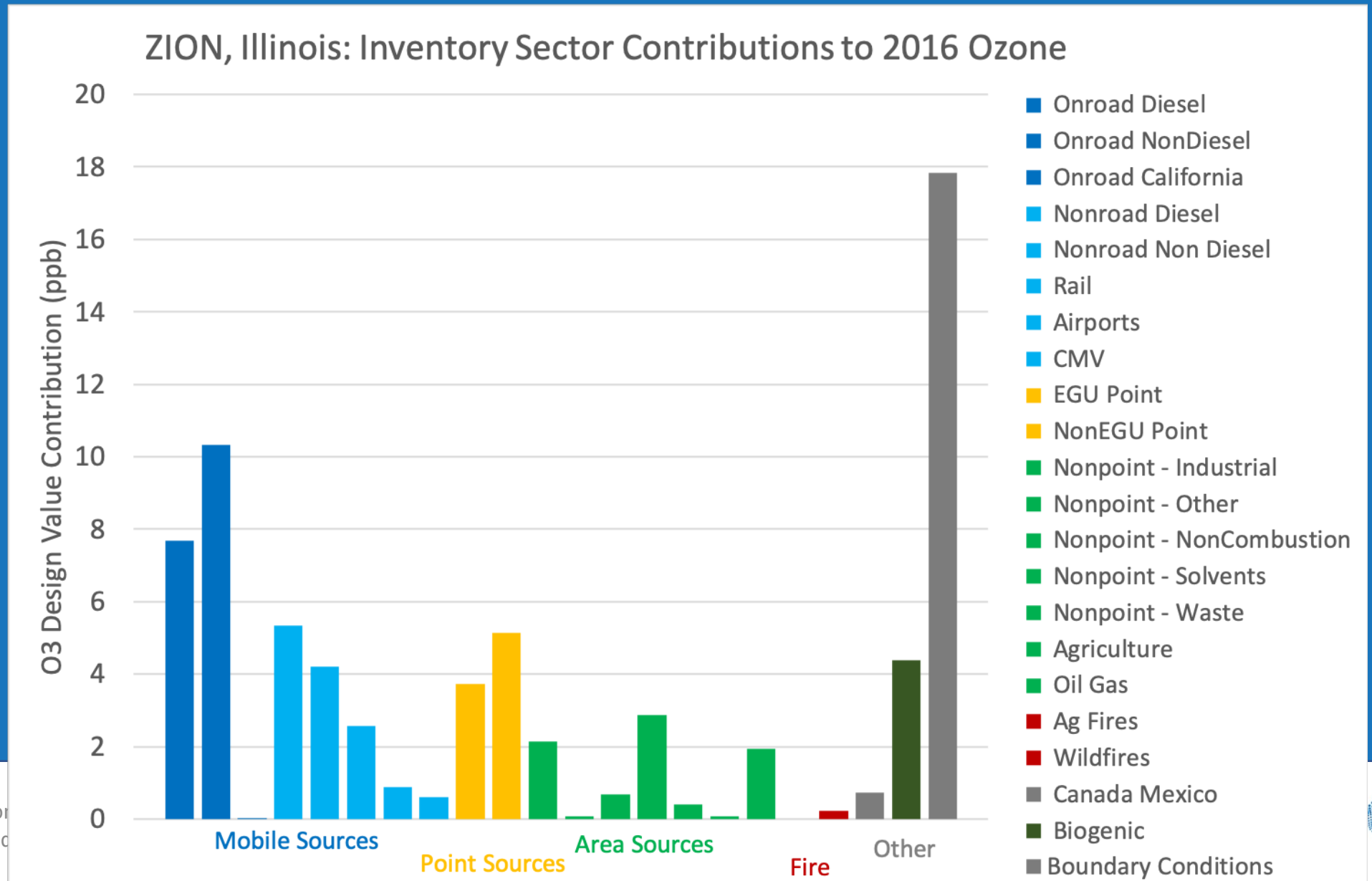


LADCO Ozone Tracer Modeling: Sectors



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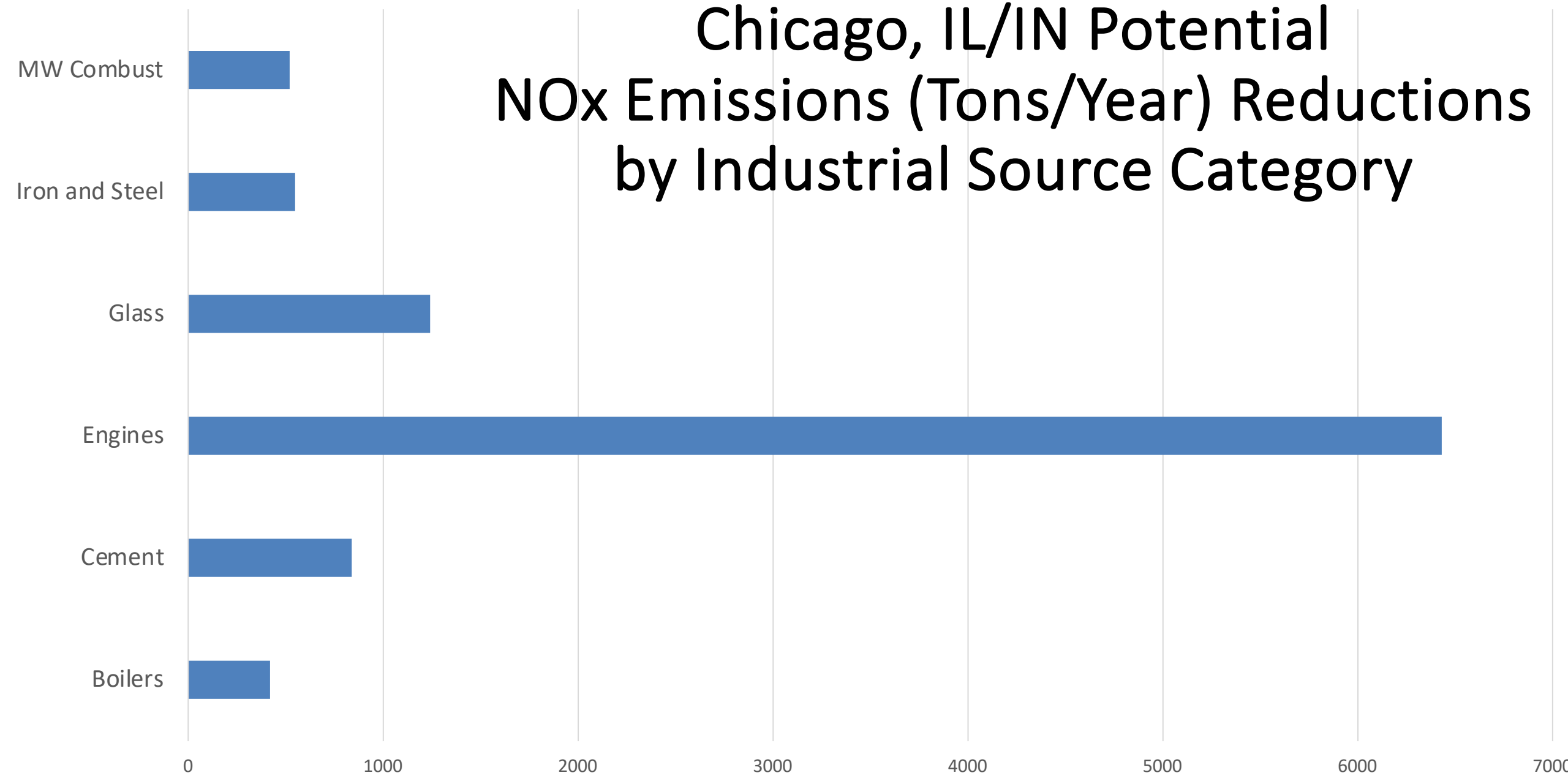
Chicago, IL/IN Potential NOx Emissions (Tons/Year) Reductions by Industrial Source Category



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Key Air Quality Planning Dates

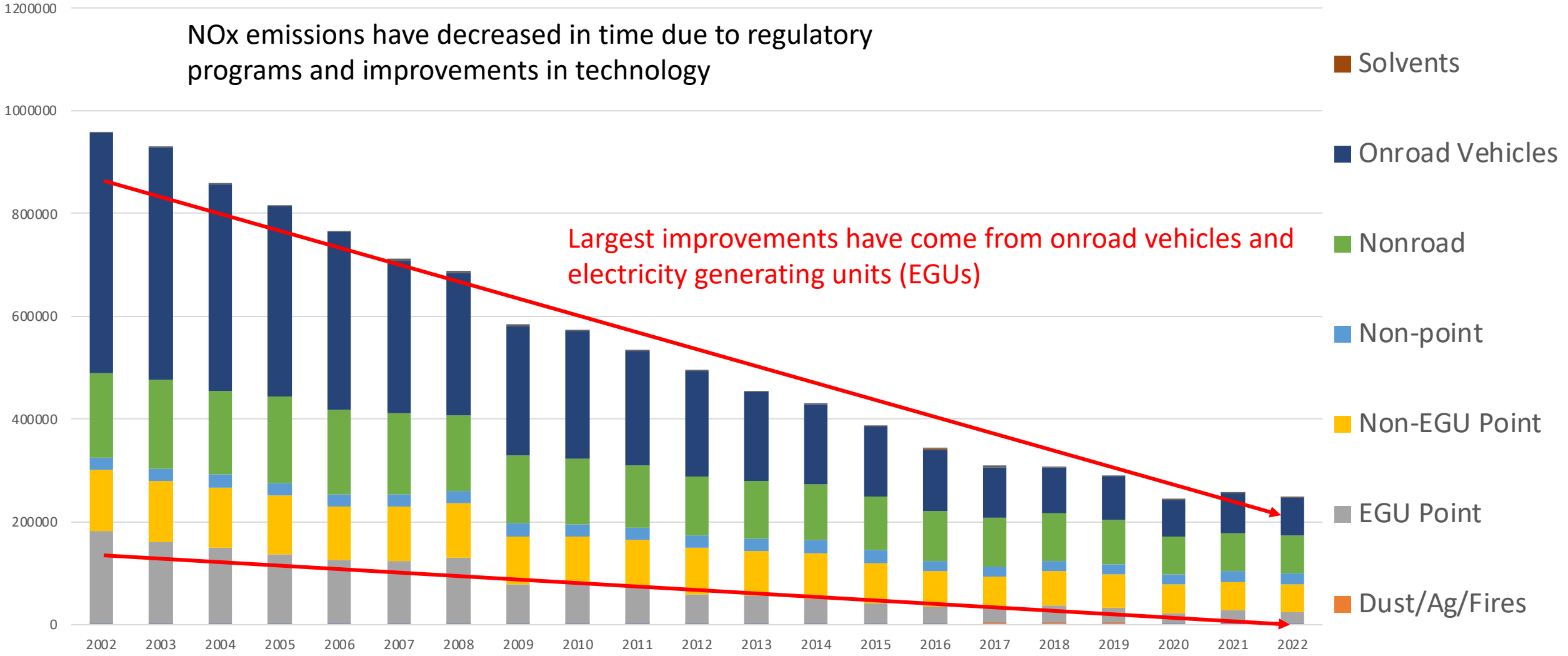
Action	Due Date	Issue	Monitoring Years
Moderate NAA attainment date	8/3/2024	2015 O3 NAAQS	2021-2023
O_3 and PM NAAQS Review	2025	N/A	
Serious NAA bump up	Winter 2024/2025	2015 O3 NAAQS	
Final Designations	2/6/2026	Annual $PM_{2.5}$ NAAQS	2022-2024
Serious NAA attainment date	8/3/2027	2015 O3 NAAQS	2024-2026
3rd Regional Haze Implementation Period SIPs due	July 2028	Regional Haze	
Attainment data	12/31/2032	Annual $PM_{2.5}$ NAAQS	2029-2031

Air Pollution Emissions

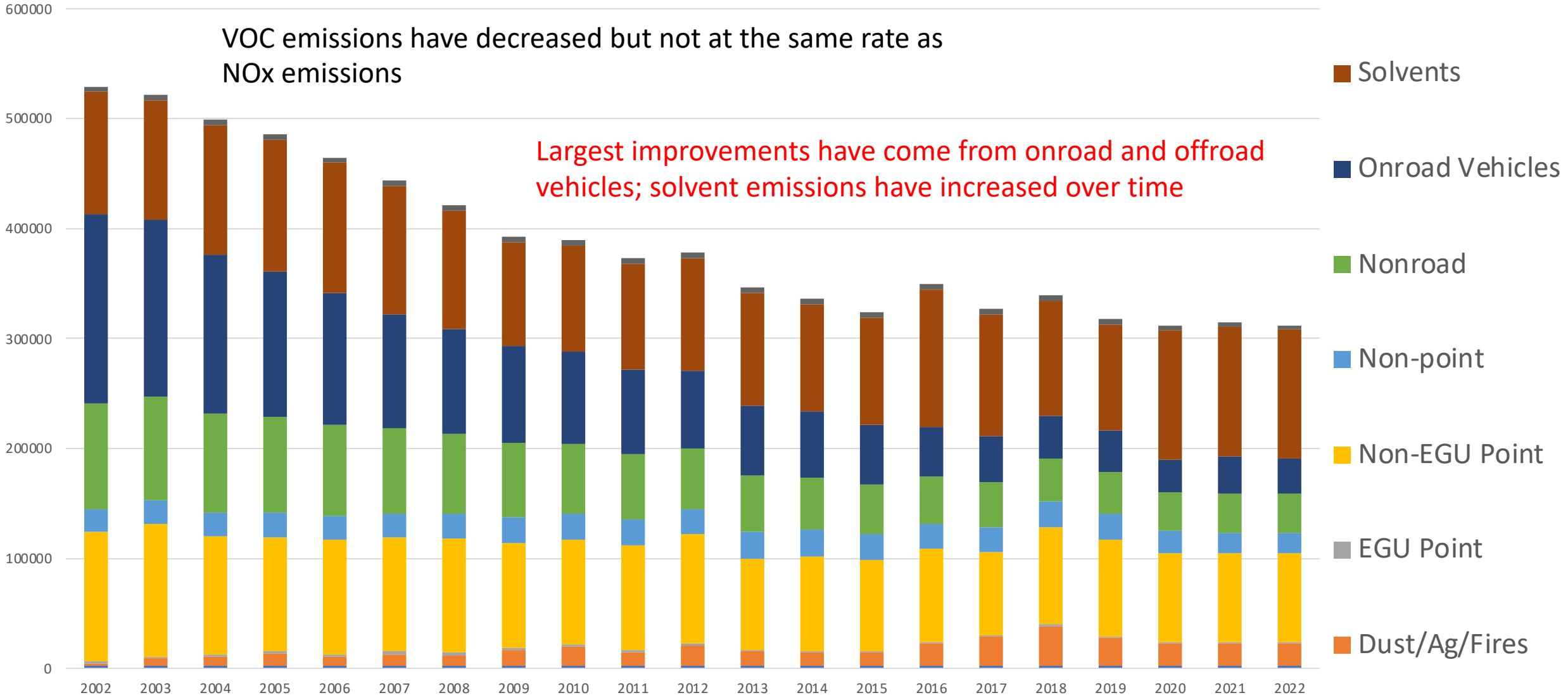
Air Pollution Emissions Inventories

- Inventory: Accounting of all sources of air pollution in an area
- LADCO compiles inventories with US EPA on many different sources.
  - Cars, trucks, trains, personal care products, trees, residential boilers, etc., etc.
- Emissions inventories are the foundation of all air quality planning decision support work
  - Trends for tracking the impacts of regulatory control programs
  - Inputs to air quality modeling
  - Forecasting tools to estimate future air quality levels

2002-2022 NOX Emissions Illinois
Tons/Year by Major Sector



2002-2022 VOC Emissions Illinois
Tons/Year by Major Sector



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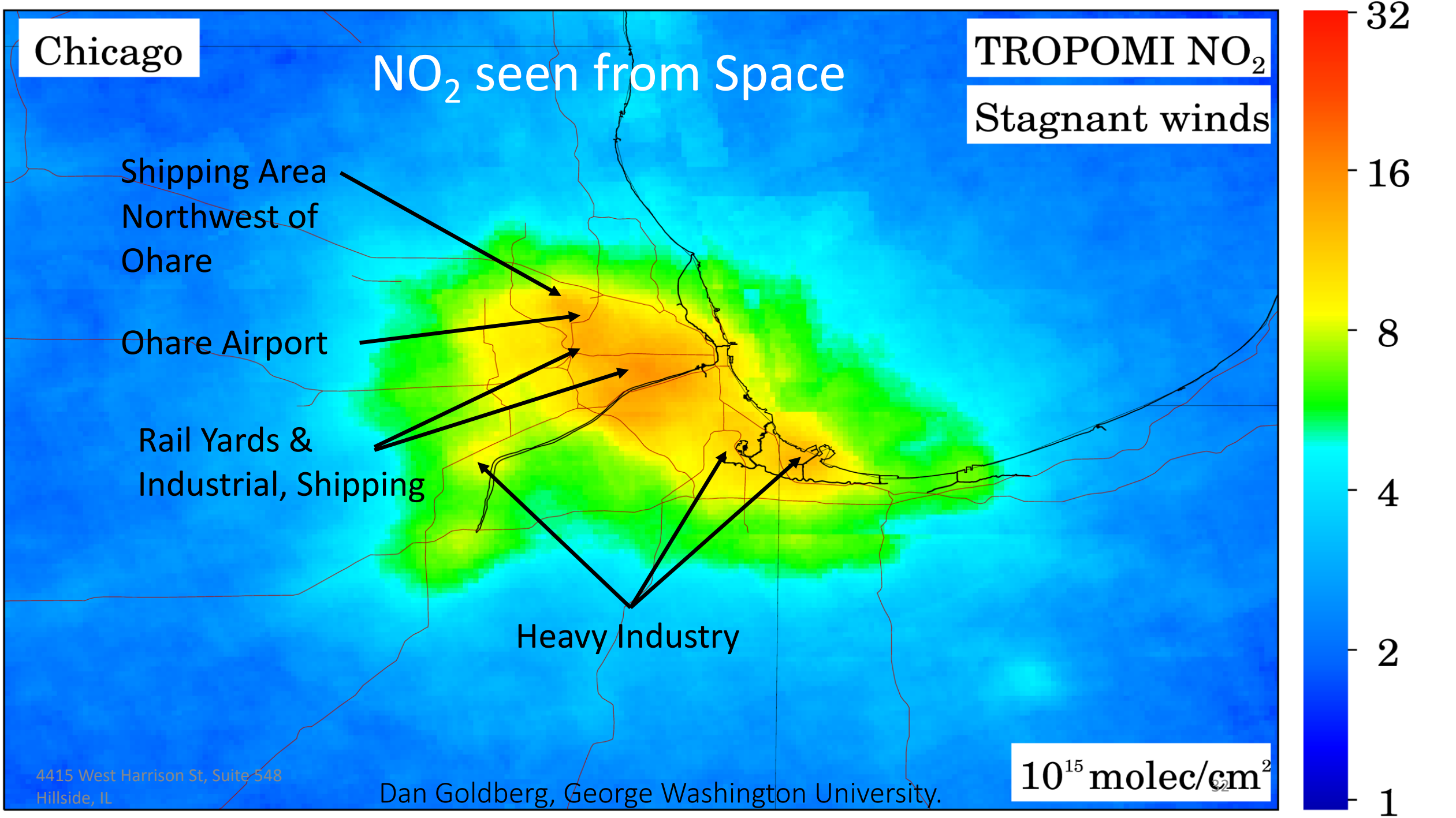

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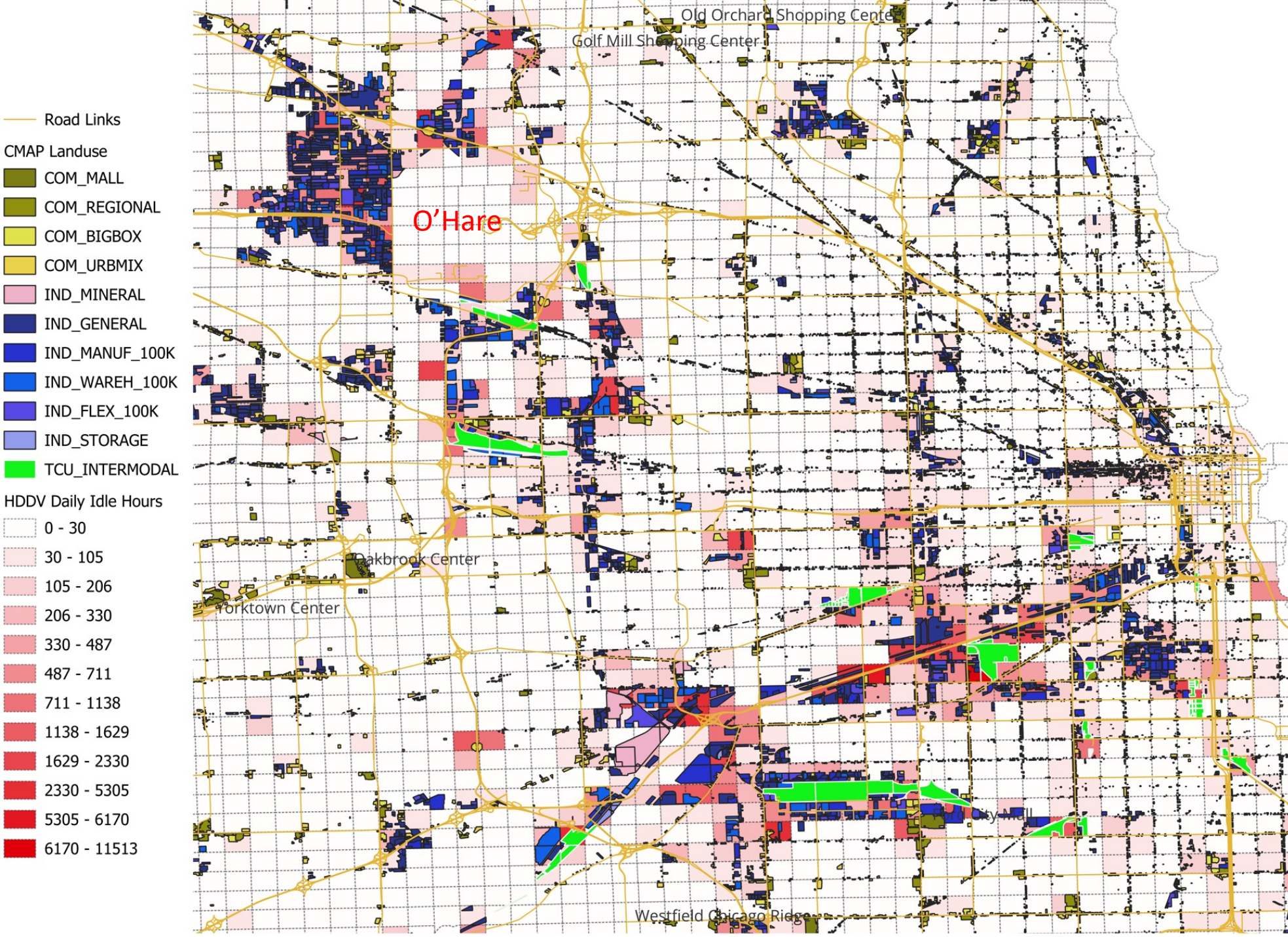
Dan Goldberg, George Washington University.

Freight and Truck Emissions in Chicago

- 1/3 of diesel trucks have some form of “Defeat Device” to bypass the pollution control system
  - Improved fuel economy and horsepower
  - NOx emissions increase 20-100x
- Long-term truck idling (>30 minutes) renders emissions control systems ineffective
  - Queuing at intermodal facilities and warehouses produce long-term idling
- LADCO is currently doing research with CMAP to understand the extent of this problem

Map of Land Use and Heavy-Duty Truck Idling Hours

- Emissions are concentrated along freight corridors
- High idling area NW of O'Hare Airport



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Air Pollution Management

Q: What can a region/state/city do to attain the NAAQS?

- Implement enforceable emissions control measures to reduce the pollutant/precursors
- Rely on federal regulatory programs, e.g., federal fuel economy standards) for emissions reductions
- Implement voluntary programs to reduce emissions, e.g., mode-shifting for transportation or public transportation incentives
- All of the above

Emissions to Air Pollution Connections

Reduce These Emissions	Impacted Pollutants
NOx, VOC	Ozone
NOx, VOCs, SO_2, Ammonia (NH_3), Soot, Dust	$PM_{2.5}$
VOCs, diesel particulates, roadway particulates	Air Toxics

Emissions to Air Pollution Connections

Reduce These Emissions	Impacted Pollutants
NOx, VOC	Ozone
NOx, VOCs, SO_2, Ammonia (NH_3), Soot, Dust	$PM_{2.5}$
VOCs, diesel particulates, roadway particulates	Air Toxics

Air Pollution Emissions Control Programs

- Goal: Identify NOx and VOC emission reduction strategies pursuant to attainment of the ozone and PM2.5 NAAQS
- Objectives
  - Identify feasible emissions control options:
    - Control technologies exist
    - Controls are cost-effective
    - Within a state or municipal agency's regulatory jurisdiction
    - Politically and publicly acceptable
    - Permanent and enforceable
  - Prioritize controls that will have an impact on NOx and VOC emissions by 2026

Priority Source Categories

- Public fleets, including buses & refuse trucks
- Short-haul diesel vehicles
- Industrial-Commercial-Institutional (ICI) boilers
- Lawn & garden equipment
- Construction equipment
- Switching engines (rail)
- Volatile chemical products (solvents, coatings, and consumer products)
- Natural gas water heating & cooking appliances

Not a source category but…diesel emissions control system defeat devices

NOx Emissions Control Options

- Public Fleets
  - Alternative fuel or low-emitting gasoline public fleet requirements (O-27, O-28, O-29, O-30)
  - Zero emissions vehicle fleet purchase requirements (e.g., CA advanced clean fleets)
  - Consider flexible procurement strategies: electrification as a service, vehicles as a service (e.g., leasing of vehicles and charging infrastructure) rather than large scale fleet purchases
  - IRA program: Climate Pollution Reduction Grants

NOx Emissions Control Options

- Short-haul Diesel
  - Idling reduction (O-15, O-20, O-21), diesel I/M (O-8), accelerated fleet turnover (O-11, O-22, O-26), zero emissions trucks (O-16)
  - Partner with MPOs and municipalities to identify operators to target for fleet turnover funding
  - IRA program: Climate Pollution Reduction Grants, Clean Ports, Clean Heavy Duty Vehicles

NOx Emissions Control Options

- ICI Boilers
  - Identify industrial process that are not using natural gas (e.g., coal, wood, or oil) and prioritize for technology upgrades
  - Incentivize ICI energy efficiency programs or technology upgrades

NOx Emissions Control Options

- Offroad Diesel Equipment
  - Accelerated deployment of zero emission equipment (N-16) or fleet turn over (N-17)
  - IRA program: Climate Pollution Reduction Grants; Diesel Emissions Reductions
  - Other programs: Phase out sale of new diesel equipment, ozone action days
- Offroad Gas Equipment
  - Exchange existing in-use equipment and fleet turn over (N-4); tier II engine replacement (N-3)
  - IRA program: Climate Pollution Reduction Grants; business owner tax credits
  - Other programs: Phase out sale of new gasoline equipment, ozone action days

NOx Emissions Control Options

- Rail
  - Idling reductions (R-2, R-4) and accelerated replacement/upgrades (R1)
  - IRA program: Diesel Emissions Reductions
- Waste Disposal – Institutional/Commercial Incineration
  - Post-combustion controls: SNCR and SCR are applicable to waste incinerators
  - NOx RACT (or MACT) for incinerators

NOx Emissions Control Options

- Residential Natural Gas Combustion
  - Heating (home and water) and cooking appliance electrification (NP-1, NP-7); weatherization, smart grid, and building efficiency rules (NP-82, NP-83)
  - IRA program: Climate Pollution Reduction Grants; homeowner tax credits
  - Other programs: Construction permits - no natural gas connections in new/renovated buildings
- Commercial Natural Gas Combustion
  - Heating (home and water) and cooking appliance electrification (NP-1, NP-5, NP-7)
  - IRA program: Climate Pollution Reduction Grants
  - Other incentives: Building owner tax deductions
  - Other programs: Construction permits - no natural gas connections in new/renovated buildings

VOC Emissions Control Options

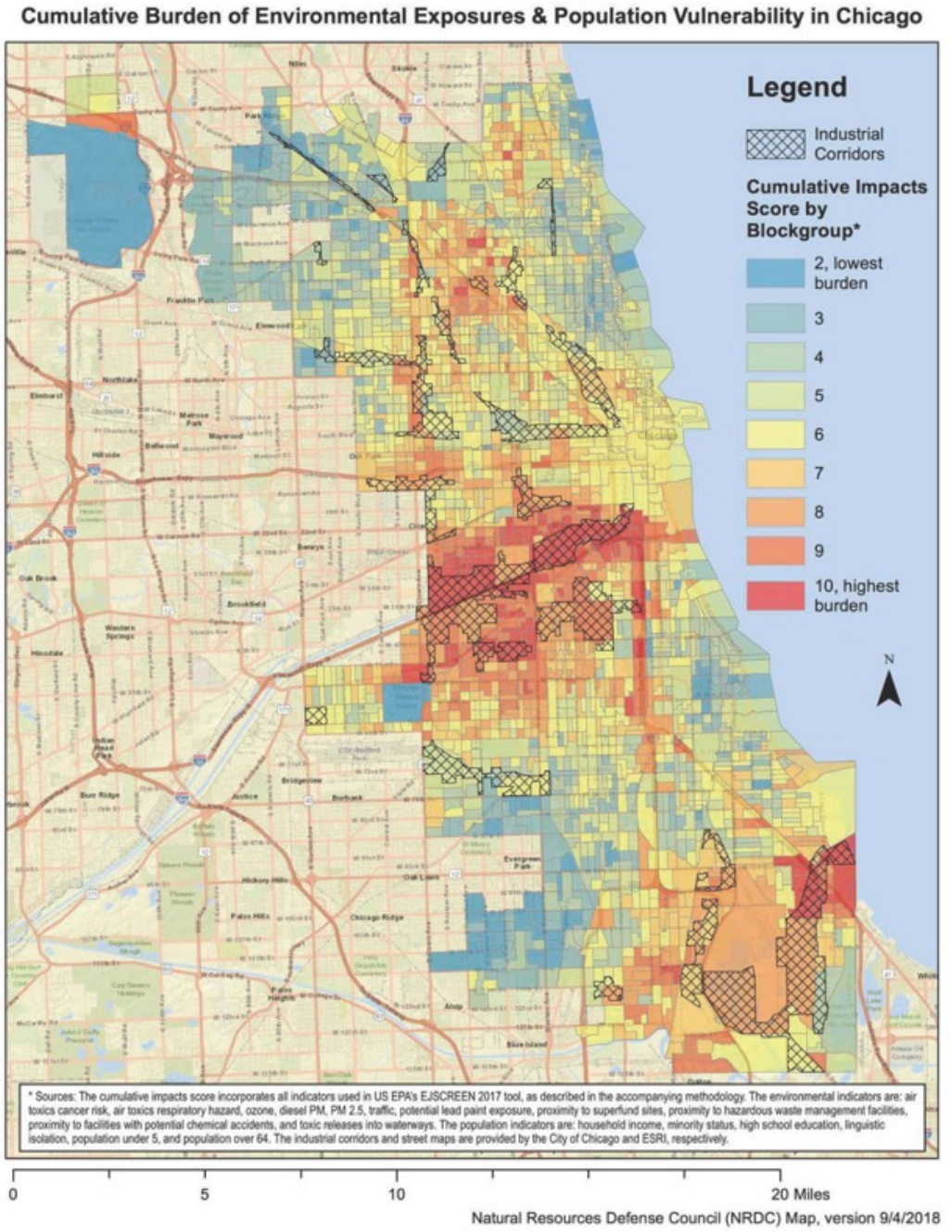
- Solvent Utilization – Consumer and Commercial Products
  - VOC content limits (NP-25 and NP-26) and reformulation (NP-27 and NP-28)
- Solvent Utilization – Coatings, Adhesives, Ink, Degreasing
  - VOC content limits (several NP-18 to NP-64)
  - UV/EP curing for coatings and inks (NP-41)
- Petroleum Product Storage - Residential
  - Controls are to electrify residential lawn and garden equipment (see NOx controls for offroad gas above)
- Petroleum Product Storage – Service Stations
  - Vapor recovery (NP-74 and NP-75) and underground tanks relief valves (NP-73)
  - Other controls: Electrify light-duty cars and trucks

VOC Emissions Control Options

- Offroad Gasoline Equipment
  - Exchange existing in-use equipment and fleet turn over (N-4); tier II engine replacement (N-3)
  - IRA program: Climate Pollution Reduction Grants; business owner tax credits
  - Other programs: Phase out sale of new gasoline equipment
- Waste Disposal – Residential/Commercial Yard Waste
  - Co-composting and green composting rules (NP-78 and NP-79)

Environmental Justice

- Low-income or communities of color are overburdened by air pollution and sources of pollution
  - Associated with structural problems with land-use zoning and development funding
- Solutions need to be collaborative and intentional
  - Data rich with impacts, locations, emissions
  - Policy tools are less clear → legal authority needs to be clarified



Chicago Cumulative Impacts Map

Yukyan Lam, NRDC

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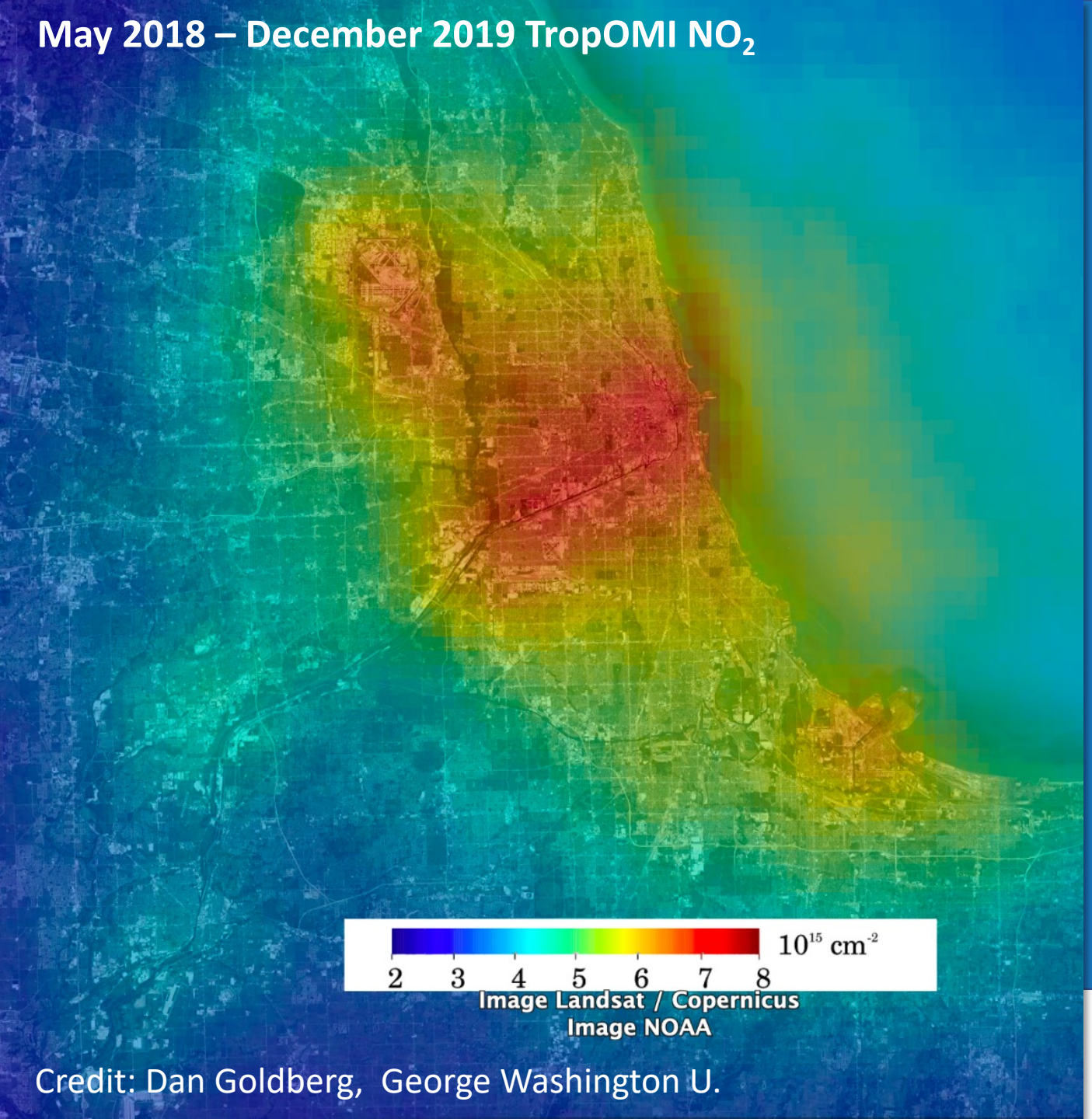
Role of Municipalities

- Work across the region to build coalitions around emissions reduction programs
- Work with state and city policy makers to identify priorities for strategies to reduce pollution
- Understand how zoning and permitting authorities need to coordinate to address injustice in air pollution burdens
- Evolve Environmental Justice policy and enforcement frameworks



Credit: Dan Goldberg, George Washington U.

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