

POLICY X POLLUTION

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SUMMARY

Data Analysis of Policy Efficacy on NYC Air Pollution



Analyzing air quality in NYC

Inspired by policy change
under Mayor Bloomberg in
2011

Investigating whether its
implementation yielded any
direct or indirect particulate
matter concentration change
to the air we breathe

POLICY

Enacted to mitigate pollution created by NYC dirty fuel burning



Report (2007):

- Highlighted challenges to NYC – one being environment
- Noted NYC's failure to remain below federal Clean Air Act standards
- Goal:
 - "Achieve the cleanest air quality of any big city in America"
 - By 2030, 80% reduction of GHG emissions by 2050

Conception:

- Environmental Defense Fund (EDF) Investigative reports: ID bunker fuel
- Developed: NYC Clean Heat Program (CHP)
- Law and policy amendments aimed to reduce air pollution and health consequences

Three policies:

- **local regulation:** Ban dirty fuel #4 & #6
- **local law:** Reduction of sulfur ppm in #4 oil (3000 -> 1500ppm)
- **state law:** Reduction of sulfur ppm in #2 oil (2000 -> 15 ppm)

How:

- Converting commercial/ residential buildings boilers, removing completely, or installing new ones
- increase the availability of natural gas and #2 diesel throughout NYC
- Different levels of assistance

Policy start: 01 APR 2011

Hard deadline: 01 JULY 2015 (Oil #6)

Long term deadline: 01 JAN 2030 (Oil #4)

FUEL

Fuel Oil: Any liquid petroleum product that is burned for the generation of heat or in an engine for generating power

Classified into six classes: #1 - #6

Increases with fuel oil number

- Composition
- Viscosity
- Price usually decreases as # increases
- Boiling point
- Carbon chain length

Heavy Heating Oils: #4 and #6

- Contain sulfur and other pollutants
- Difficult to burn completely
- Unburnt oil becomes soot that spews out of the chimney

#4

- Blend with 50% #6 (Dirtiest) oil & #2 (ultra low sulfur) oil

#6

- Most pollutant & highest sulfur concentration
- Emits sulfur dioxide & greater amounts of other pollutants
- Least expensive & dirtiest
- Viscous, solid at room temperature



After 2030:

Only three types of heating fuel allowed:

- biodiesel
- natural gas
- solar
- steam service
- electric heat pumps
- #2 oil. Ultra-low sulfur (ULS 2)

Separate deadline to phase out:

- **#6:** June 30, 2015. 100% gone
- **#4:** January 1, 2030 (Still 50% blend of #6)

The heating oils used in 1% of buildings make up 85% of the heating oil soot. More than all NYC vehicles combined – upgrading these buildings is the largest step for air pollution”

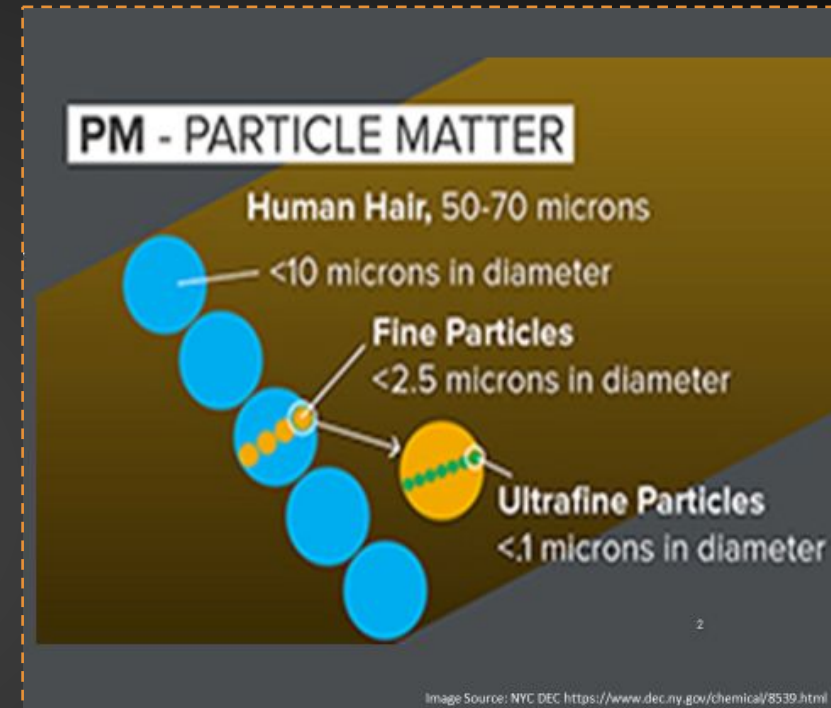
- President, Environmental Defense Fund

PARTICULATE MATTER

PM: Microscopic aerosol particles made up of a single or multiple compounds of pollutants

PM_{10} , $PM_{2.5}$, PM_{10}

- **$PM_{2.5}$** is the abbreviation for fine particulate matter with a diameter < 2.5 microns
- PM are tiny solid particles or liquid droplets in air
- **Blue** circles: **PM_{10}**
- **Orange** circles inside the **blue** circle: **$PM_{2.5}$**
- **Green** circles inside the **orange** circle: **$PM < 0.1$**



Categorized by size and abbreviated as “PM” with a number subscript

- $PM_{2.5}$ is fine PM: diameter less than 2.5 microns
- Within $PM_{2.5}$ are finer particles, such as PM_{10} , that make up the whole of $PM_{2.5}$
- PM_{10} is coarse PM: particles 10 microns in diameter or smaller
- Contain union of smaller PM densities to make up its total mass concentration.

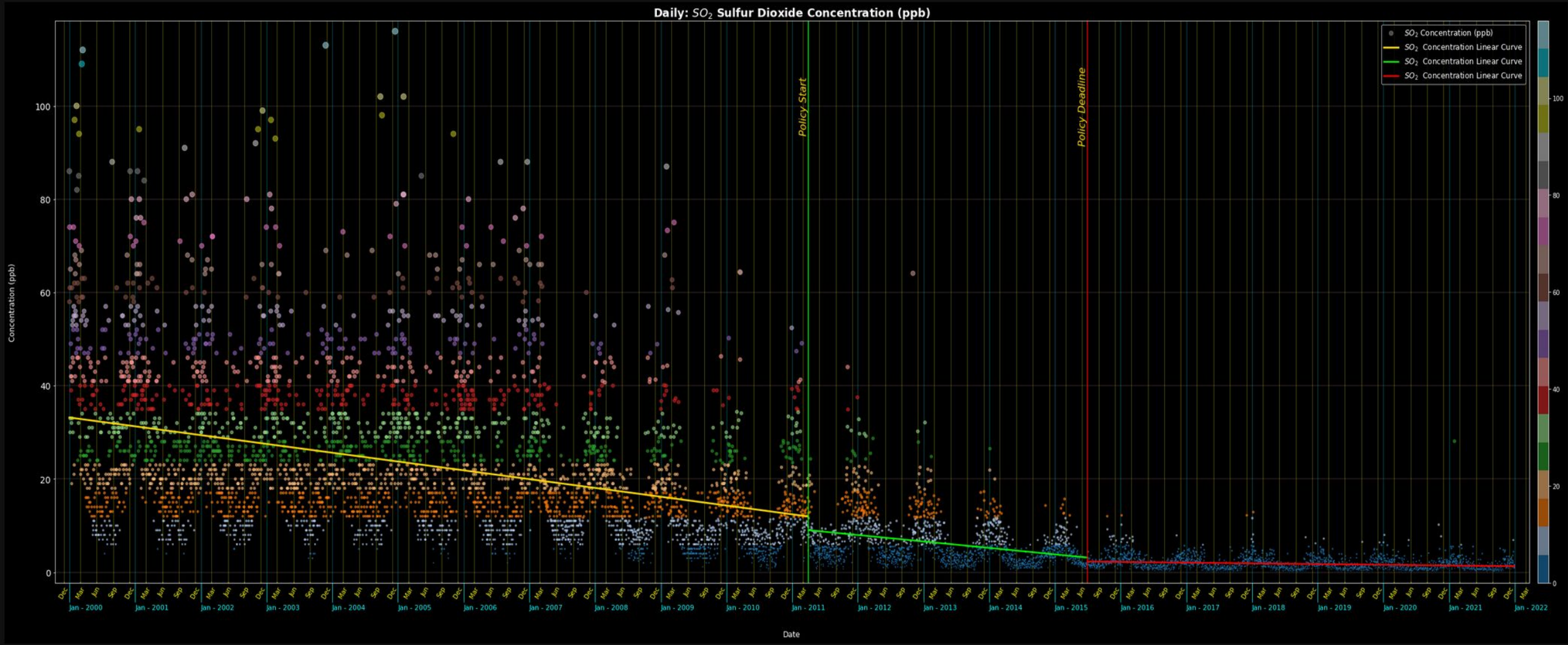
PM in NYC is primarily produced by daily anthropogenic activity

- **17%** of the emissions from automobile traffic
- **19%** from aviation, marine vessels, and other non-road entities
- **11%** from dust from the roads, the subway, and construction
- **Major source** of PM in NYC - **50%** from buildings heating, cooking, and gas, etc.

POLLUTANTS

I	PRIMARY						
	Concentration: ppm/ ppb & PM2.5	Ia	COMPARISON	Concentration: ppm/ ppb & PM2.5	Ib	COMPARISON	EPA Air Pollution Compounds
	SO2 Sulfur Dioxide			SO2 Sulfur Dioxide			CO Carbon Monoxide
	SO4 Sulfate (Created from SO2)			SO4 Sulfate (Created from SO2)			SO2 Sulfur Dioxide
2	LOCATION	2a	LOCATION	New Jersey Counties			NO2 Nitrogen Dioxide
	New York			Bergen			O3 Ozone
	Bronx			Essex			C Carbon
	Brooklyn			Hudson			
	Manhattan						
	Queens						
	Staten Island						

NYC SO2



Pre 2011

- Mean Concentration: 22.5 ppb
- Trend: Decreasing

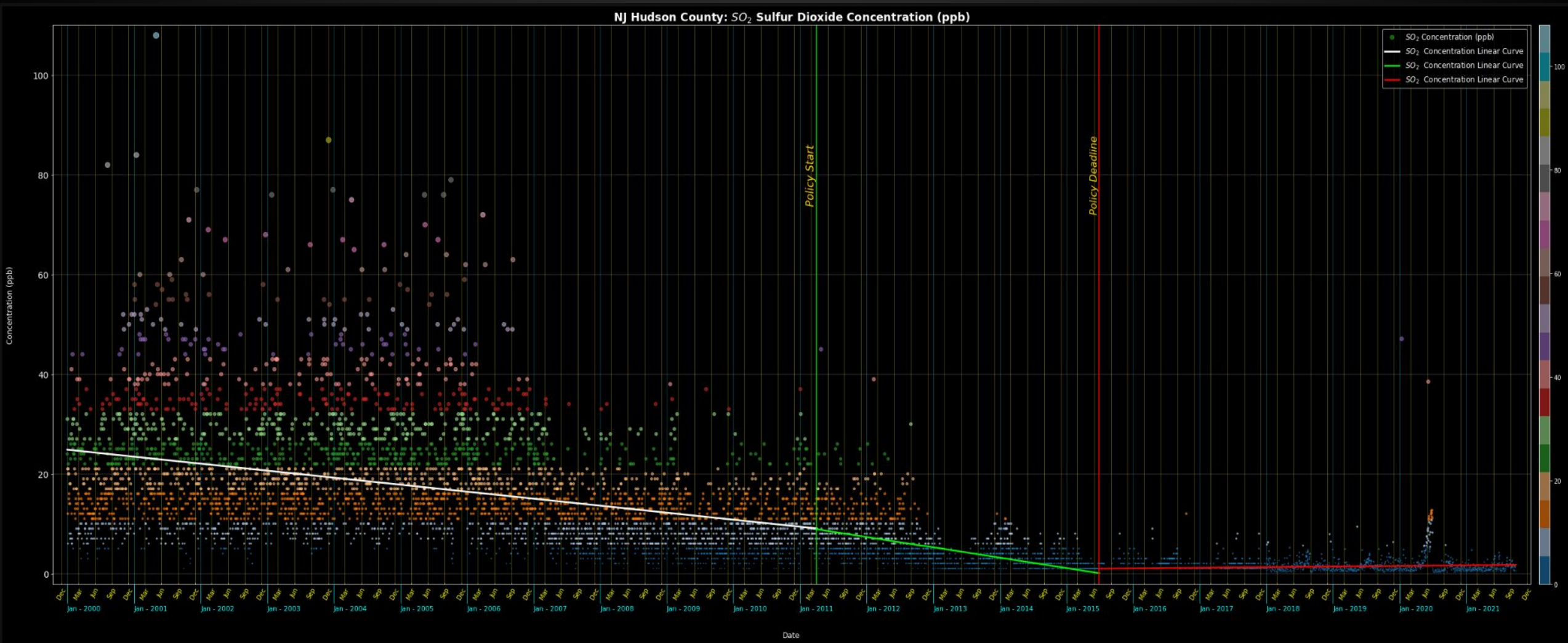
2011 – July 2015

- Mean Concentration: 6ppb
- Trend: Decreasing

July 2015 - 2022

- Mean Concentration: 1.8
- Trend: Decreasing

NJ SO2



Pre 2011

- Mean Concentration: 17 ppb
- Trend: Decrease

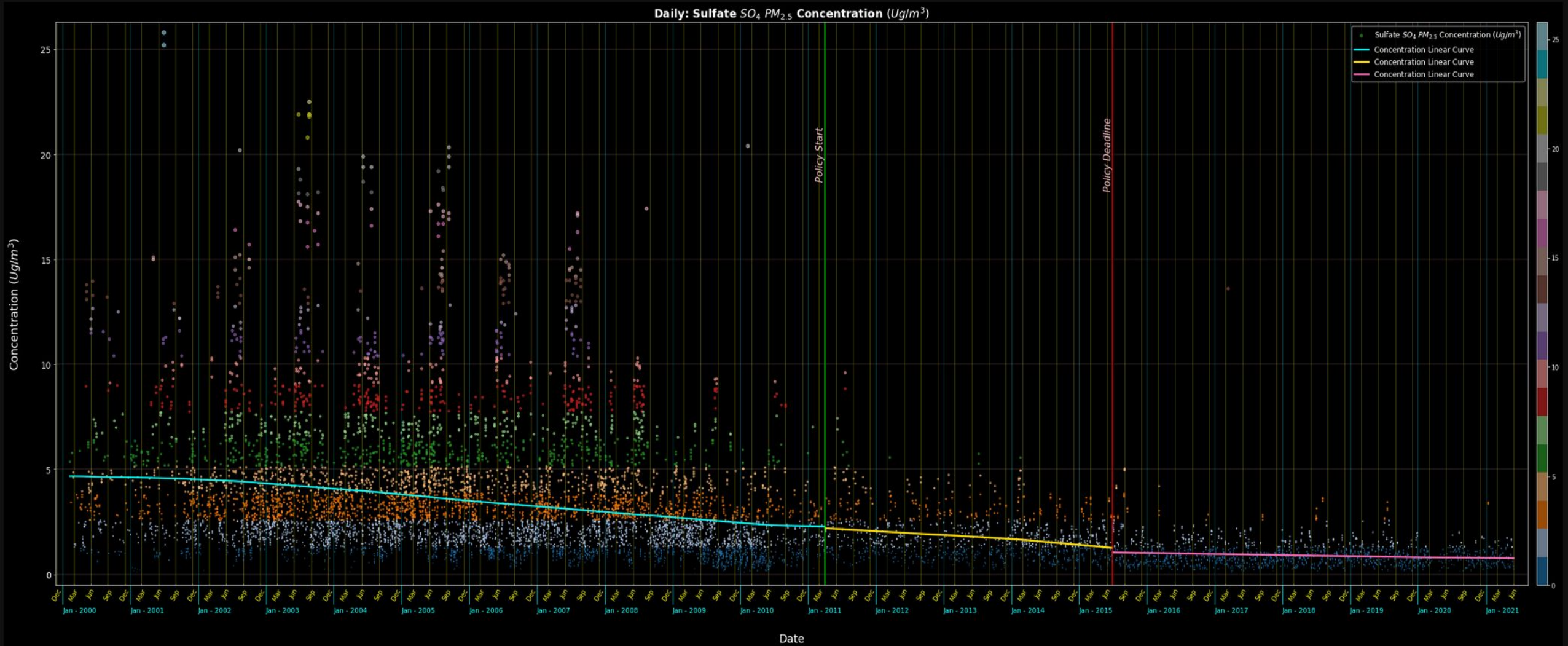
2011 – July 2015

- Mean Concentration: 4.4 ppb
- Trend: Decrease

July 2015 - 2022

- Mean Concentration: 1.3 ppb
- Trend: Increase

NYC SO4



Pre 2011

- Mean Concentration: 3.5 Ug/m^3
- Trend: Decreasing

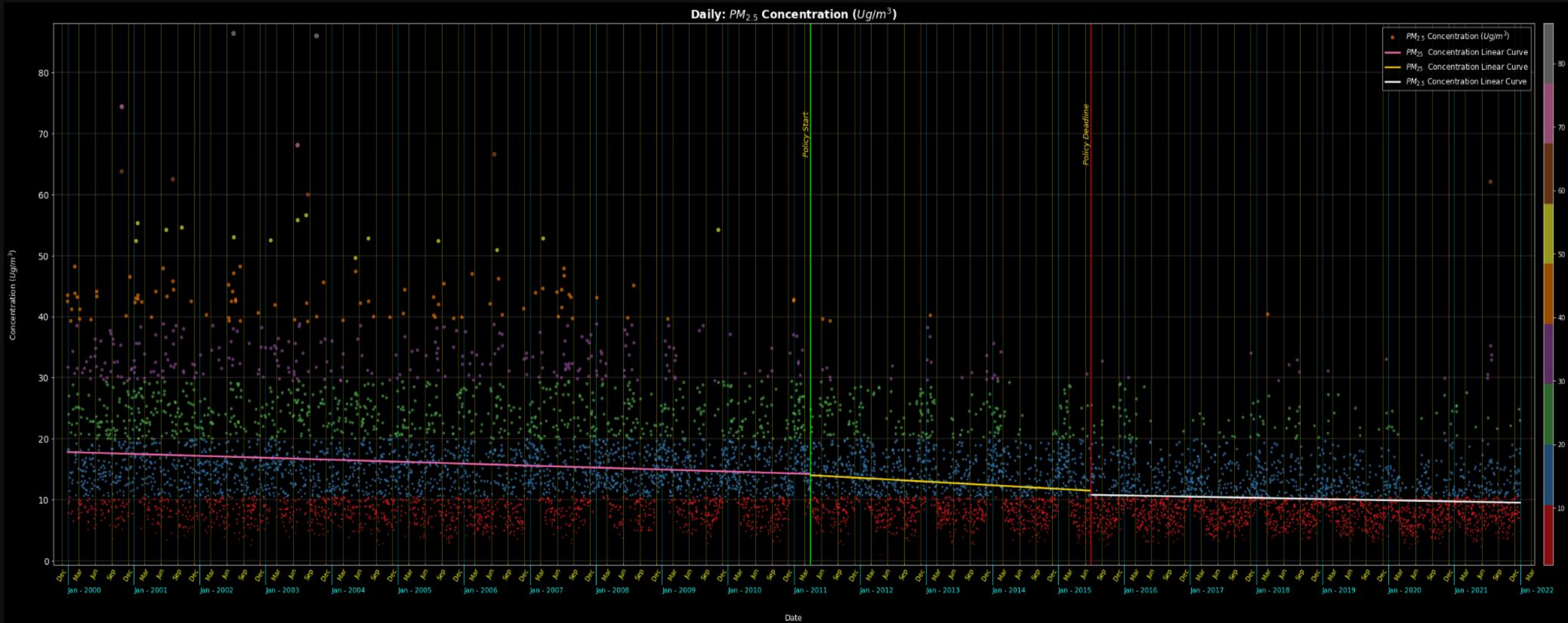
2011 – July 2015

- Mean Concentration: 1.7 Ug/m^3
- Trend: Decreasing

July 2015 - 2022

- Mean Concentration: 0.9 Ug/m^3
- Trend: Decreasing

NYC PM2.5



Pre 2011

- Mean Concentration: 16 Ug/m^3
- Trend: Decreasing

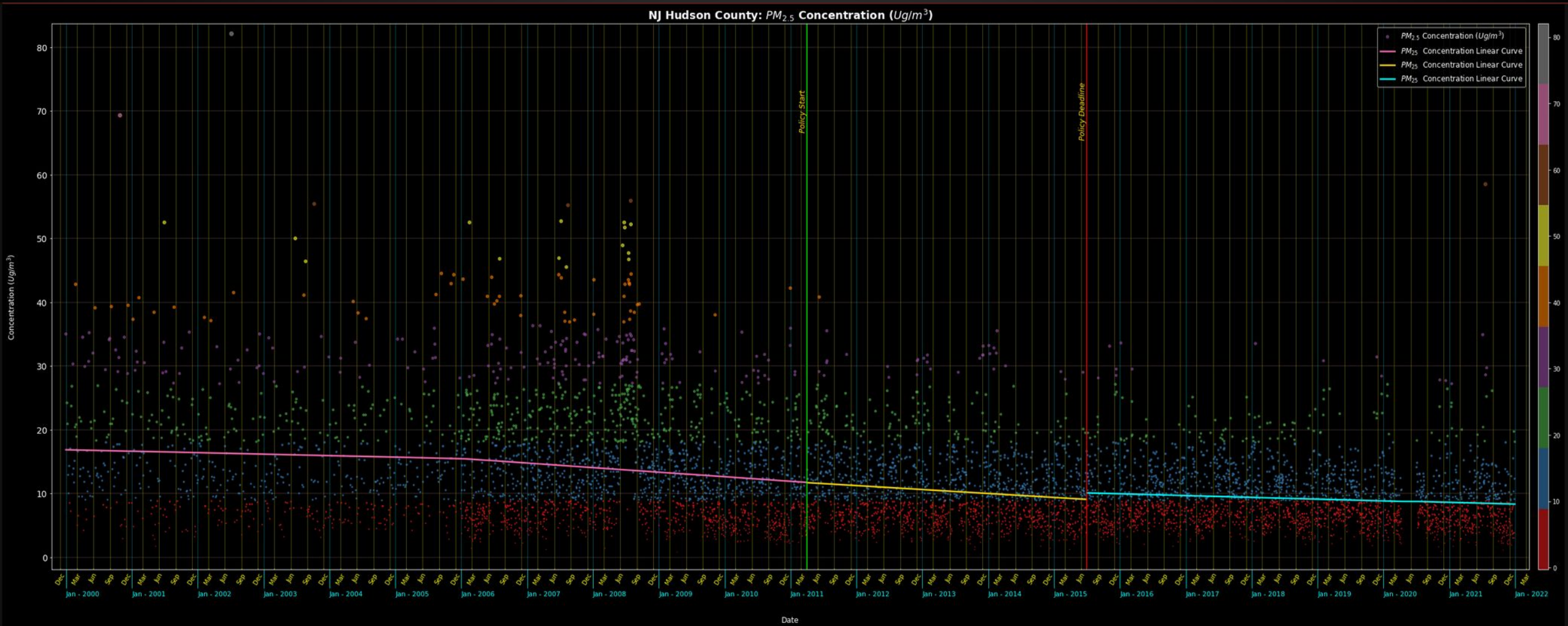
2011 – July 2015

- Mean Concentration: 12.7 Ug/m^3
- Trend: Decreasing

July 2015 - 2022

- Mean Concentration: 10 Ug/m^3
- Trend: Decreasing

NJ PM2.5



Pre 2011

- Mean Concentration: 14.2 Ug/m^3
- Trend: Decreasing

2011 – July 2015

- Mean Concentration: 10.3 Ug/m^3
- Trend: Decreasing

July 2015 - 2022

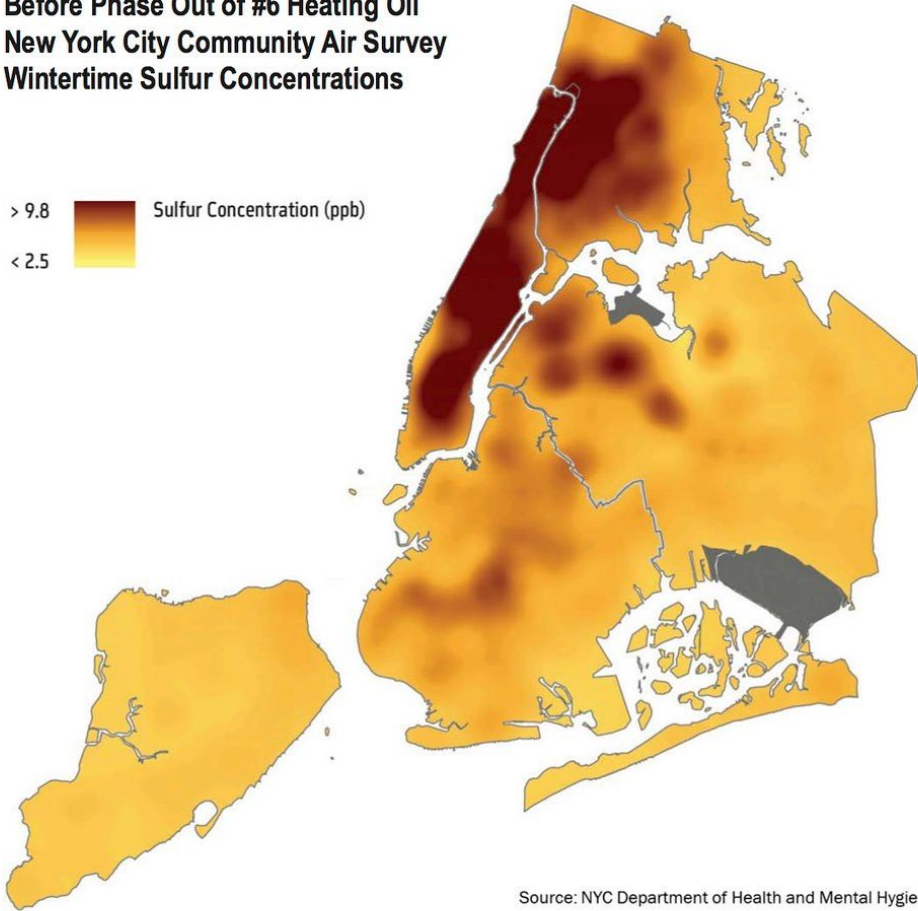
- Mean Concentration: 9.2 Ug/m^3
- Trend: Decreasing

NYC MAIN DATA LOCATION:

Before Phase Out of #6 Heating Oil
New York City Community Air Survey
Wintertime Sulfur Concentrations

> 9.8
< 2.5

Sulfur Concentration (ppb)



Source: NYC Department of Health and Mental Hygiene



ISSUES

Assessment:

- 10,000 buildings burning the cheapest, heaviest, and dirtiest oil
- Buildings burning #6 must switch to #4, #2, or other clean options
- Buildings burning #4 may continue through 2030
- 1529 buildings (47%) that were burning #6 switched to cleaner oil
- Several switched to #4 (still noxious)
- Switch to #4: cleaning the boiler and changing the oil

Cost to convert:

- Converting boilers to burn #4: \$5,000 - \$17,000 or more
- More \$ to switch to #2
- Switching to natural gas can cost hundreds of thousands of dollars



Compliance and Conversion Tapered effect

Availability of fuels

Lack of infrastructure

Deadline Waivers

Costs to Convert

Fear of fuel cost

Cheap or frugal landlords

- Smaller building's face economic hardship
- Lower income neighborhoods
- Parts of the city lack infrastructure - sufficient natural gas supply did not exist
- Buildings with financial hardship could seek an extended schedule for complying
- More than 200 public schools are among the buildings that must make the switch
- Some landlords who would otherwise switch to gas are choosing #4 oil instead
- Many plan to switch to natural gas but are waiting for gas supply to be available



MOTIVATION

Issues Caused by PM Pollution

Environmental Greenhouse Gas Concern

Adverse effects on public health

- Fine PM_{2.5} more harmful when inhaled due to microscopic size
 - Travel deeper within the lungs and enter the bloodstream
- Breathing dense concentrations of fine PM may increase:
 - Respiratory symptoms and diseases
 - Chronic Bronchitis
 - Stroke
 - Cancer
 - Asthma
 - Decreased lung function
 - Cases of death in those affected by heart and lung disease
- Anthropogenic PM directly affecting the population in a negative way

NYC Department of Health Annual Report:

- 3,000+ deaths
- 2,000 hospital admissions for lung & heart conditions
- ~ 6,300 ER visits for asthma, respiratory, & cardiovascular disease
- Prime contributor to thousands of premature deaths



Alicia Barksdale lives in Upper Manhattan next to a building that burns #6 fuel oil. She keeps her windows closed because chimney smoke.

Credit: Victor J. Blue for The New York Times

Concern

- Black soot coats apartment windows and gets inside homes
- Covers furniture
- Avoid moving to nicer apartments on higher floors

Historically poor health and social disadvantage of residents in Northern Manhattan and the South Bronx, as indicated by higher poverty concentrations

Neighborhoods with the highest density of boiler conversions – such as northern Manhattan, northern Queens, and the South Bronx – saw the greatest improvement in air quality with the greatest proportion of health benefits occurring in vulnerable, high poverty areas.