NOAA's Air Quality Assessments

What We've Learned! What It Means!

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ESRL Dedication and Open House

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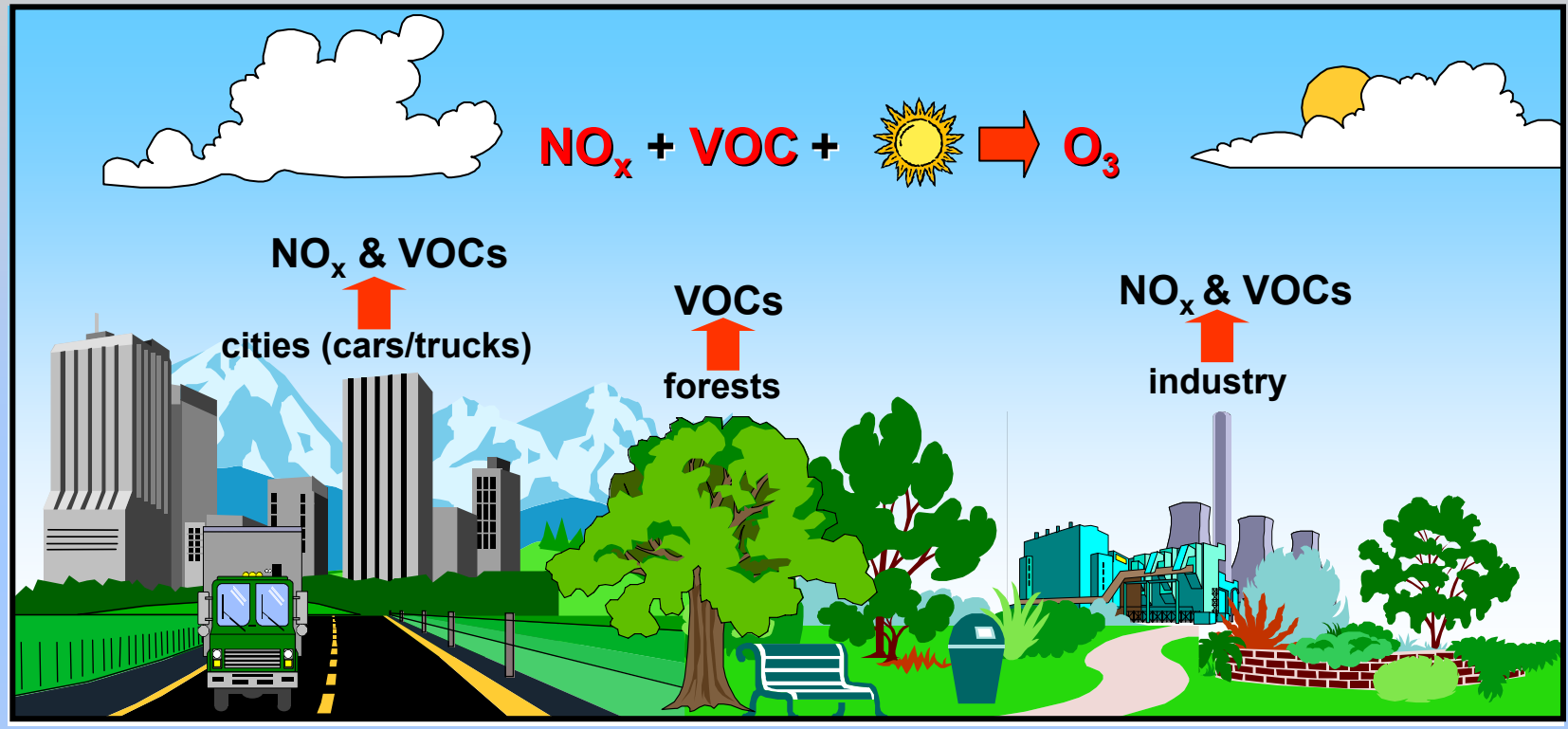
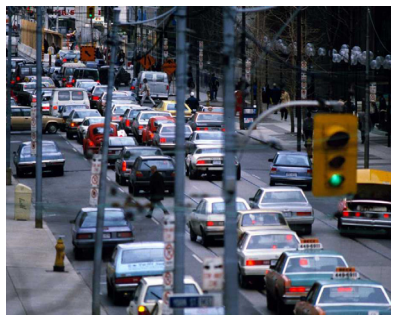
What We've Learned! What It Means!

Ozone Pollution: Who's Ruining the Neighborhood?



- Most ozone in the lower atmosphere is produced by photochemistry during the day.
- Ozone is a persistent secondary pollutant.
- Successfully reduced ozone in cities where these emissions dominated VOC produced O_3.
- Pollution persisted/worsened.



Early ozone management strategies emphasized reductions of human-made emissions of VOCs.

Focus: Automobile exhaust.

Don't Mess with Mother Nature

Response to NOAA Findings

Regional Management: *The 8-hour Standard.*

Ozone persistence/distributed sources: a regional issue.

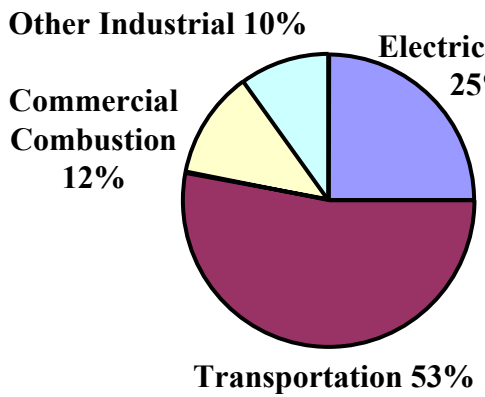
Nitrogen Oxide Management

Target NO_x.

Focus: NO_x emissions from transportation.

Transportation NO_x sources difficult to manage. Other sectors?

Anthropogenic NO_x Emissions in the United States



in both rural and urban areas and on regional scales!

The "So What" Factor:

NOAA results encouraged a flexible management strategy. NO_x & VOCs; regional & local scales.

ssions

- isoprene from trees,
- ~ 60% of total VOCs,
- peaks in summer.

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

Atlanta

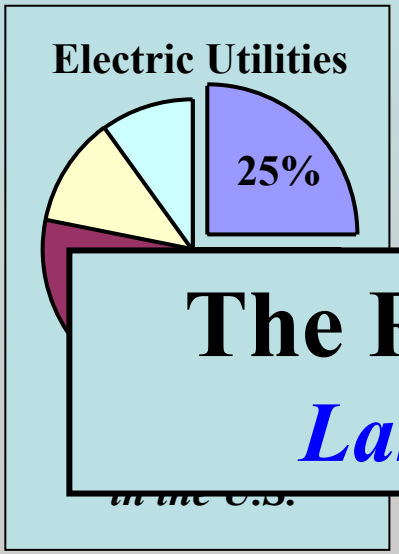
r

e formation

NO_x Emissions from Electric Utilities Power Plants

Affect attainment of ozone standard two ways:

1. ***Local ozone exceedances.***
2. ***<u>Regional ozone background.</u>***



Location of fossil-fueled electric utilities NO_x sources (1469)

The Right Size in the Right Location

Large Isolated Power Plant Sources

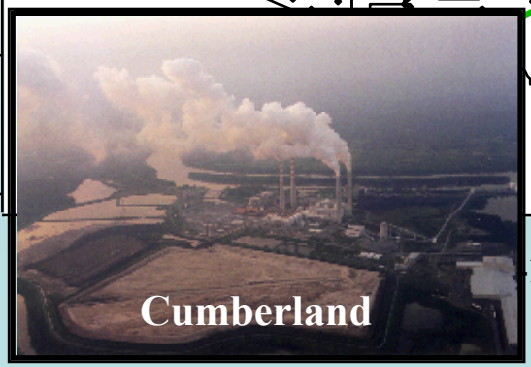
Relative NO_x Emissions

Cumberland ≈ 1

Johnsonville ≈ 0.13

Nashville ≈ 0.5

Cumberland and Johnsonville: Similar locations, different in size.



Johnsonville

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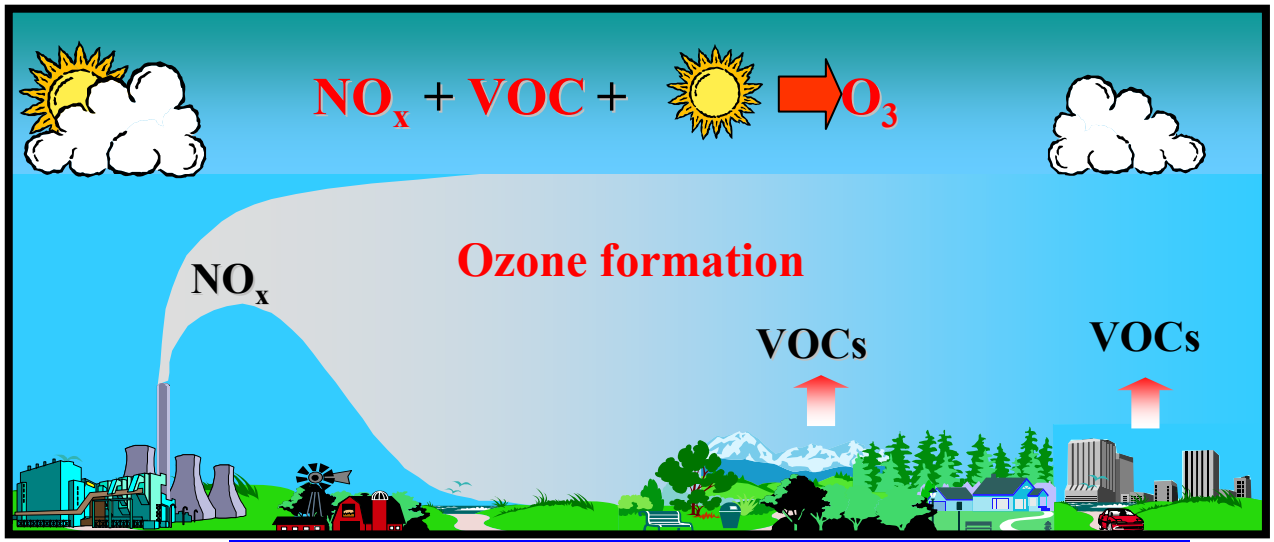
TIFF (Uncompressed) decompressor
are needed to see this picture.

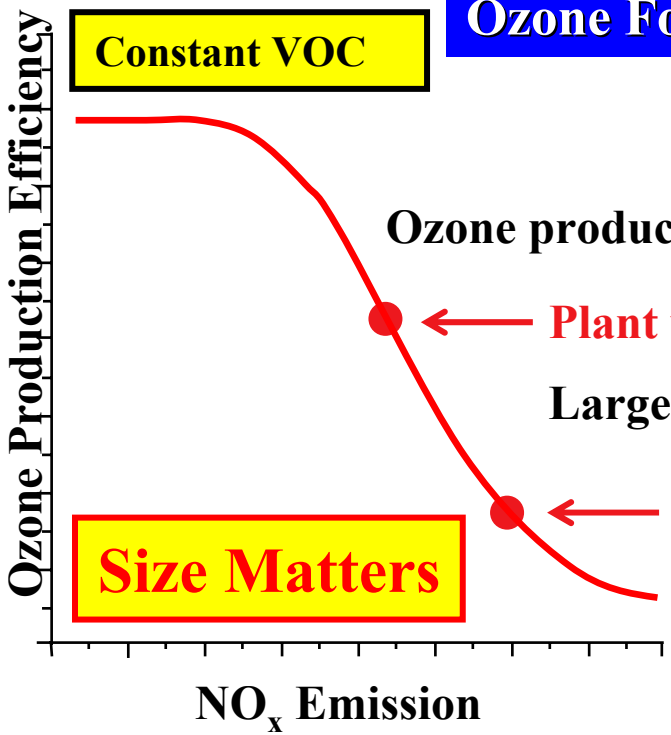
100

Longitude

Ozone Formation in Power Plant Plumes



Ozone Formation is a Nonlinear Process



Ozone production efficiency (OPE) depends on NO_x emitted.

Plant with smaller NO_x emissions (e.g., Johnsonville)

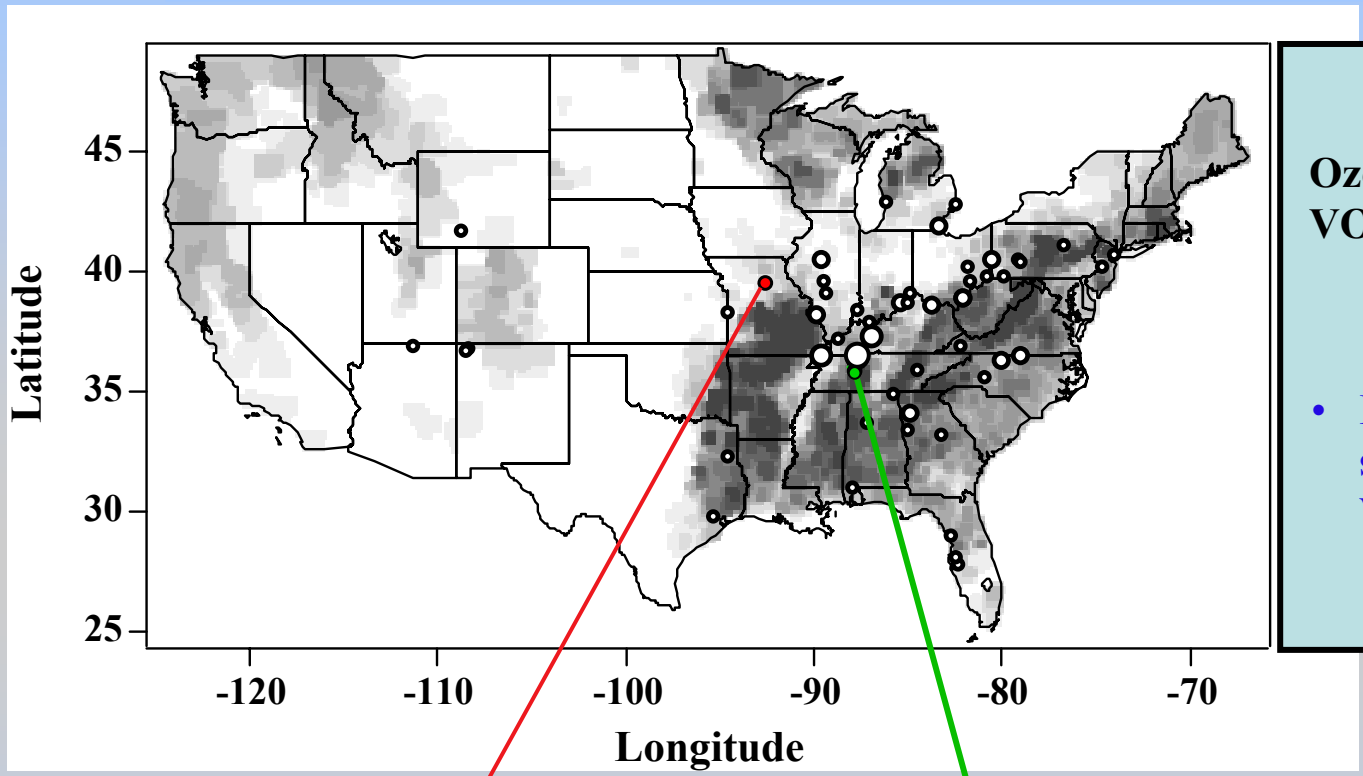
Larger NO_x sources produce proportionally less O_3.

Plant with larger NO_x emissions (e.g., Cumberland)

For large sources: Benefits of NO_x reductions are partially offset by increased efficiency of ozone formation.

The Influence of Location

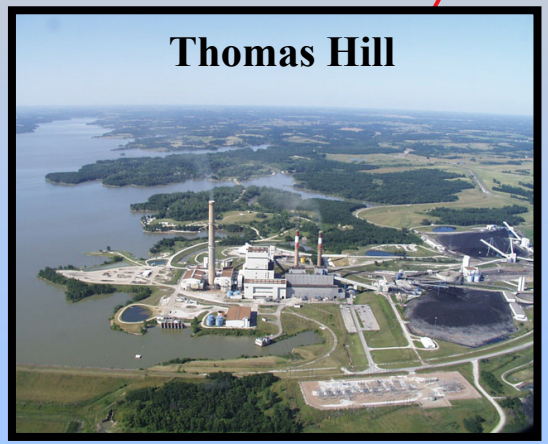
Power plant location and surrounding land-use affects ozone formation.



Ozone formation depends on VOCs.

- **Power plants do not emit significant amounts of VOCs, but forests do.**

Thomas Hill



Johnsonville

QuickTime™ and a
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are needed to see this picture.

Johnsonville located in a forest with large VOC emissions.

Thomas Hill, with similar emission, located in non-forested area with small VOC emissions.

Findings

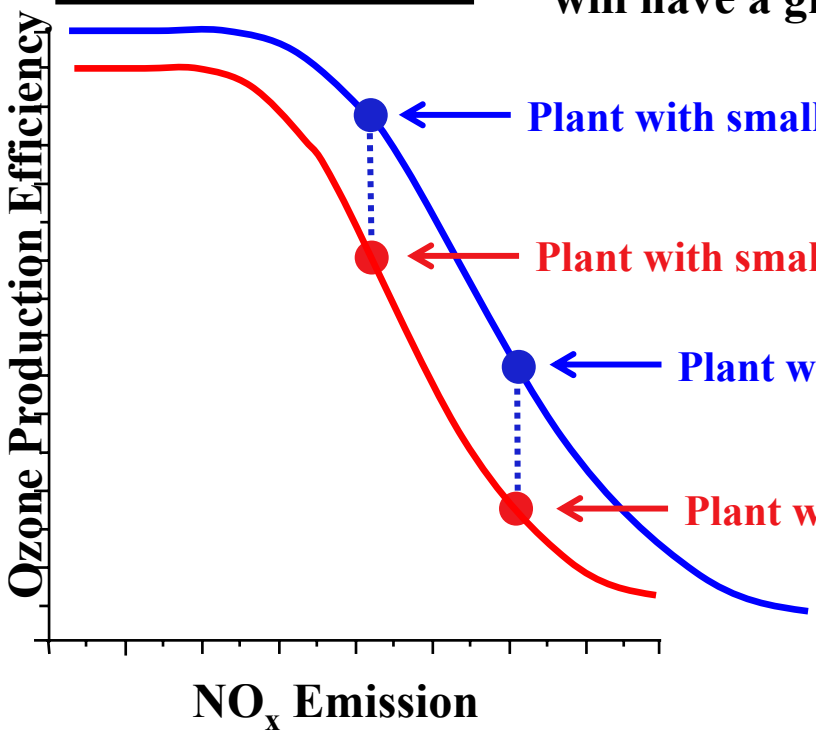
Non Linearity and Ozone Production Efficiency (OPE) - Size Matters!!!

For large sources: Benefits of NO_x reductions are partially offset by increased efficiency of ozone formation.

Impact of VOC Emissions from Forests - Location Matters!!!

At Constant VOC

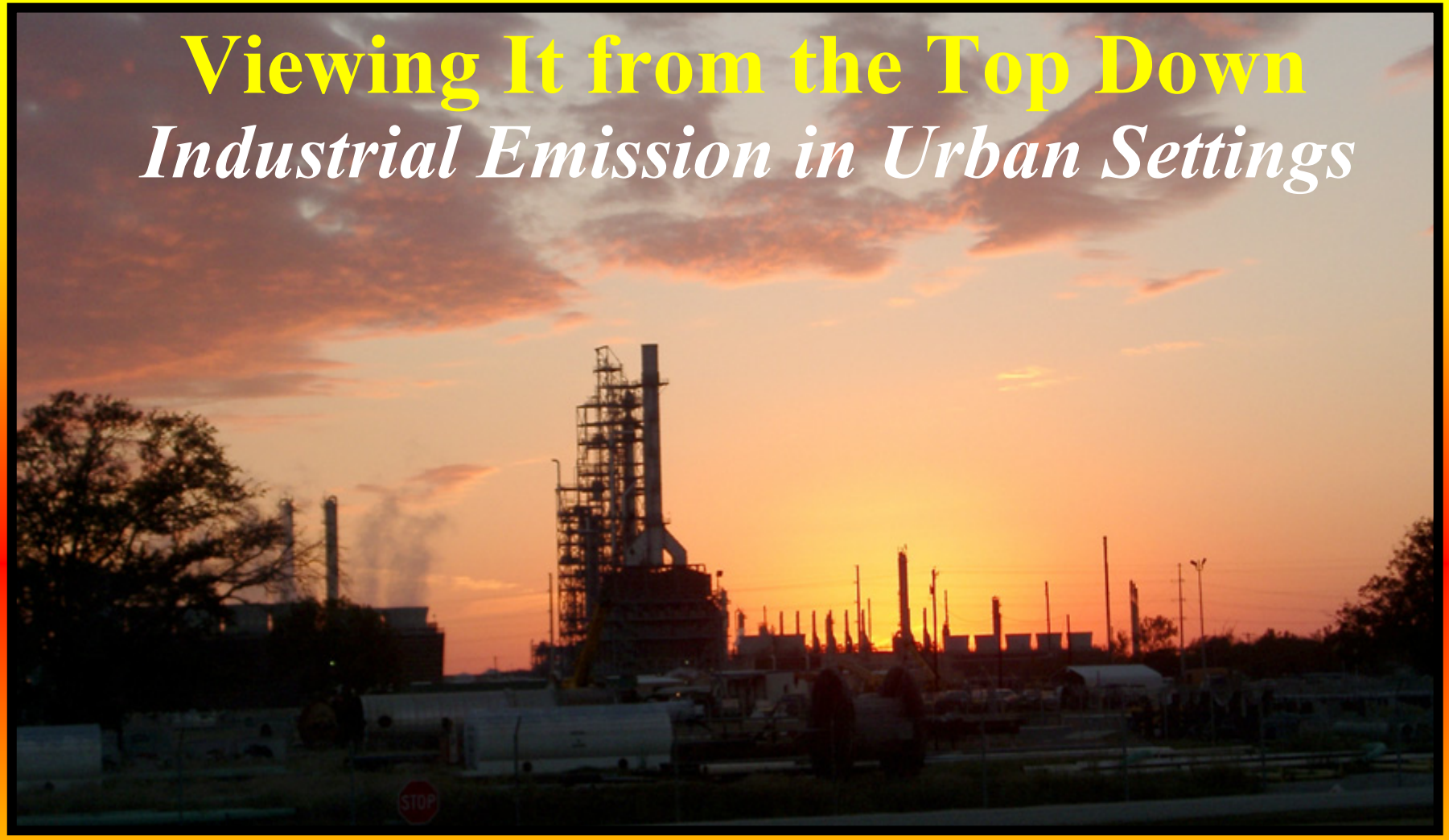
For the same NO_x emission, power plants located in forests will have a greater efficiency for ozone production



<u>The "So What" Factor</u>:
Provided new guidance for size and location of new power plants.

Viewing It from the Top Down

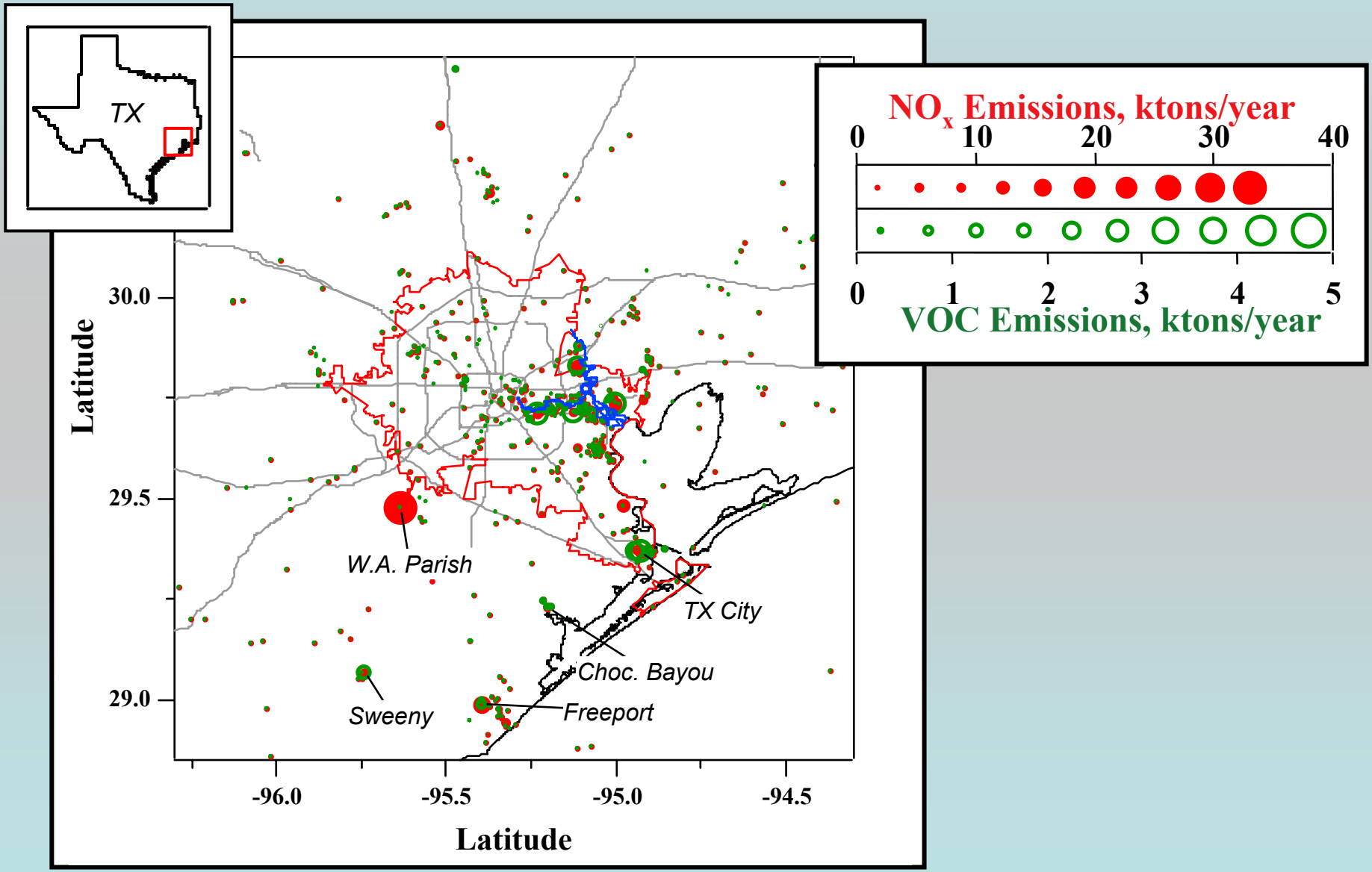
Industrial Emission in Urban Settings

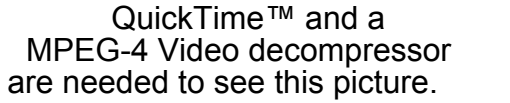


The Houston area has approximately 50% of the nation's petrochemical capacity.

Industrial Emission in Urban Settings

Location of Industrial Sources of Ozone Precursors

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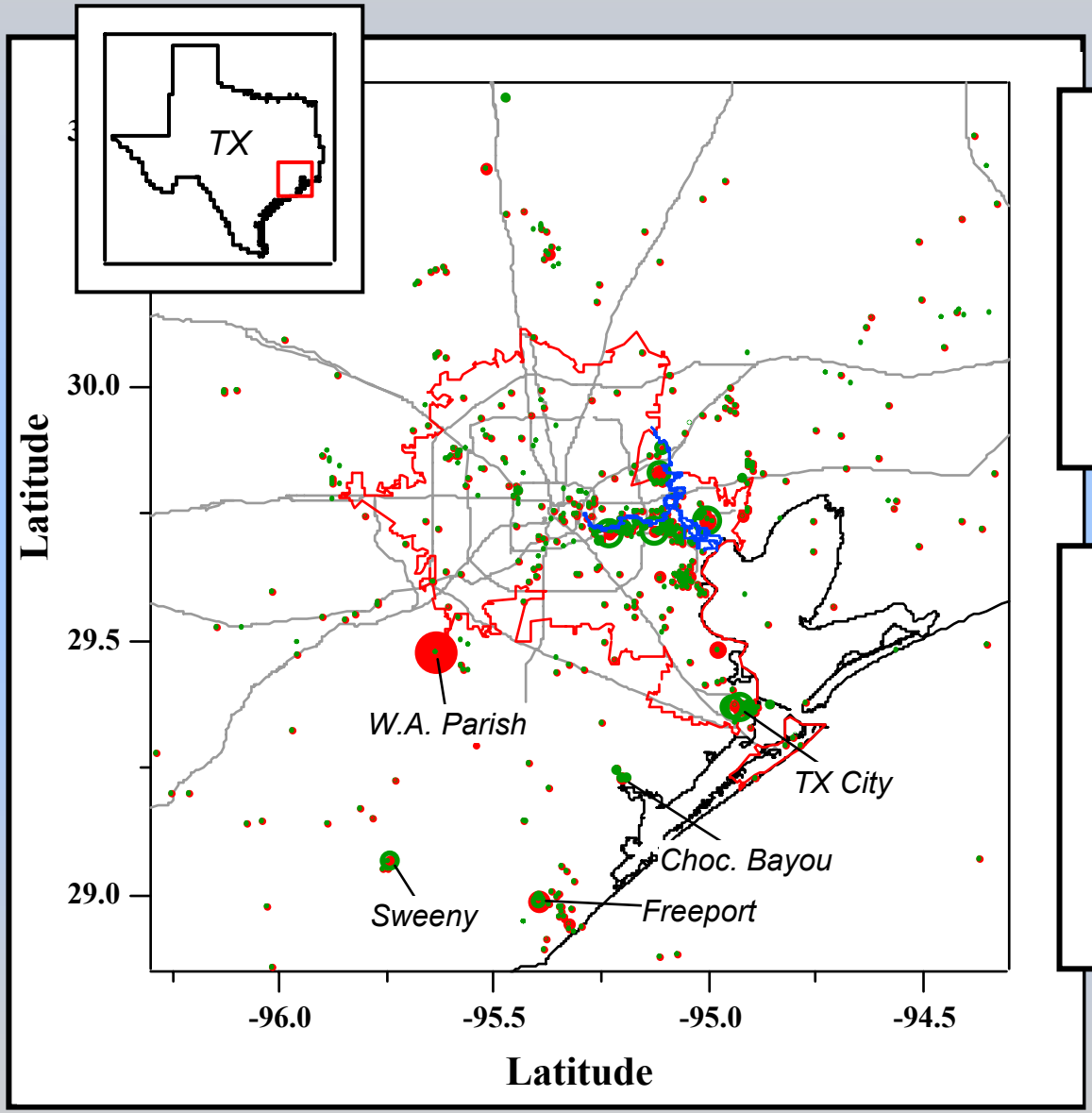
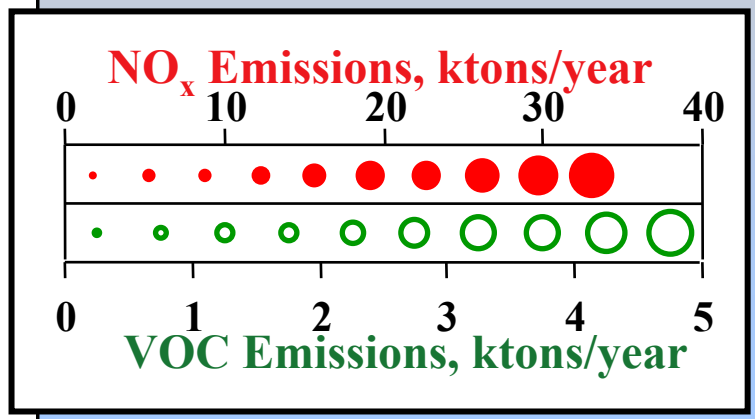
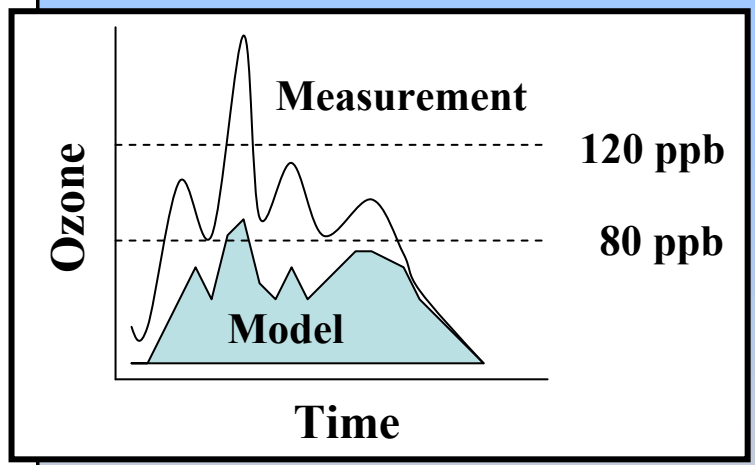
Understanding Ozone Formation in Houston

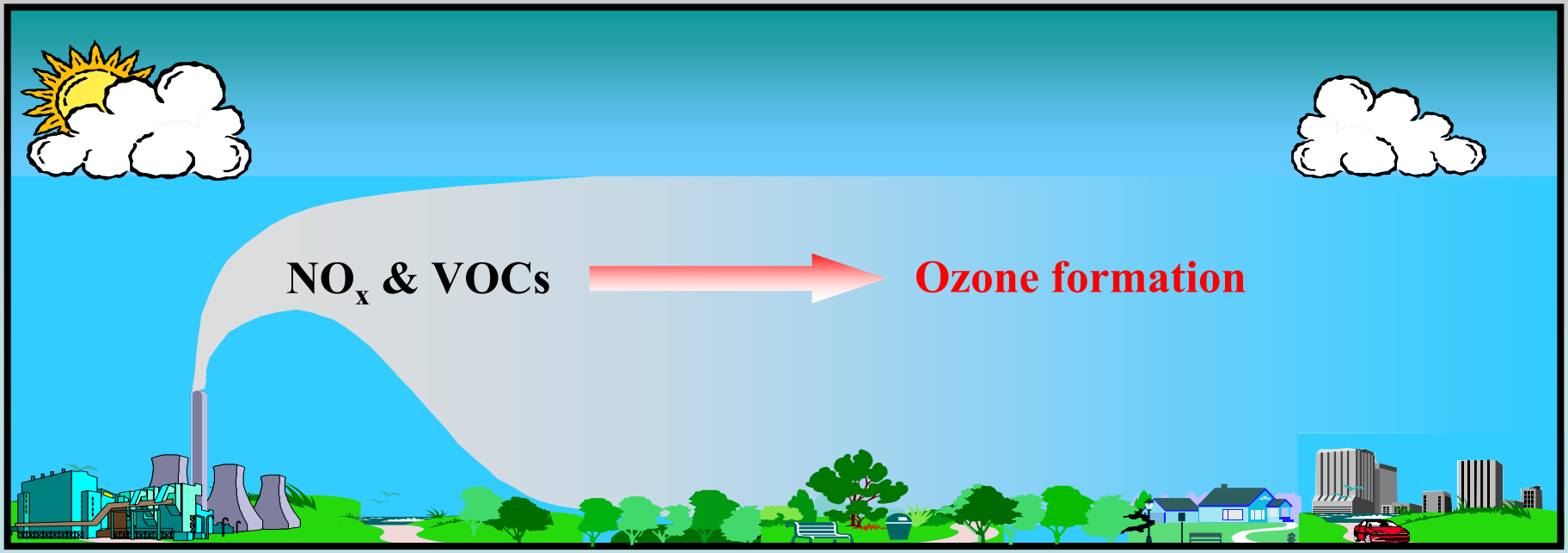


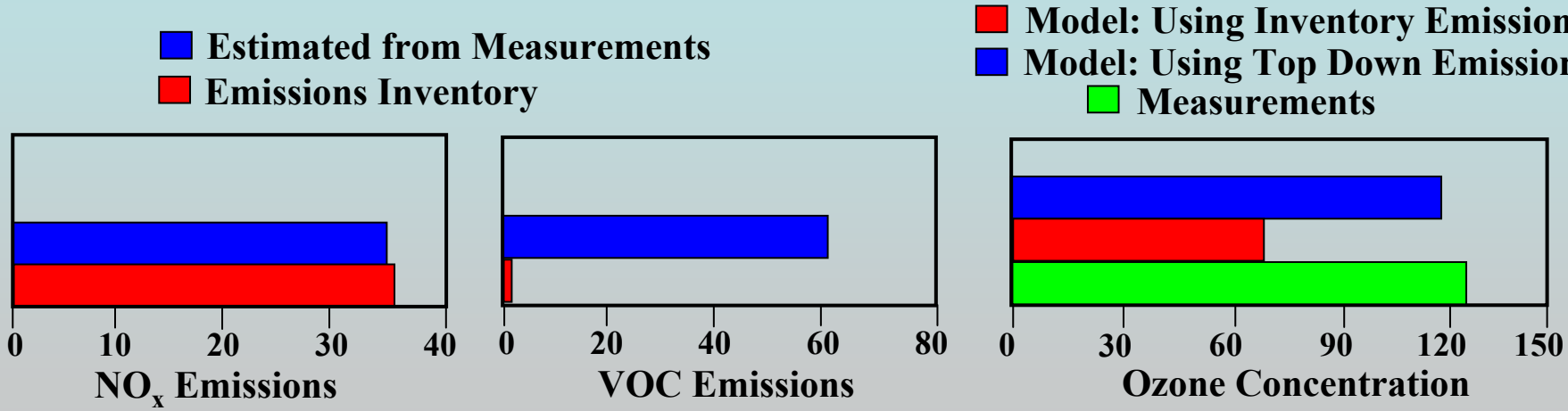




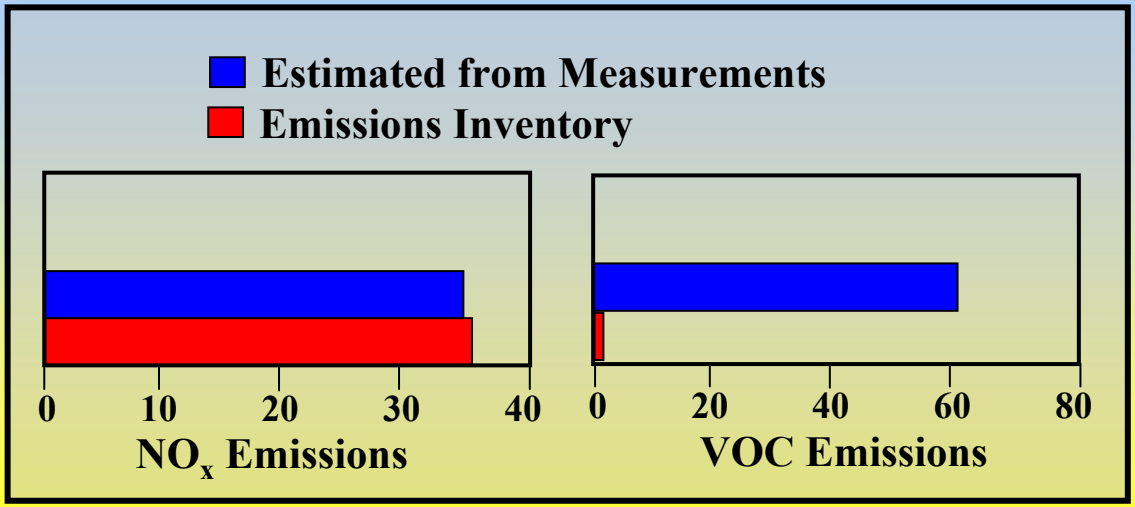
- Weird chemistry?

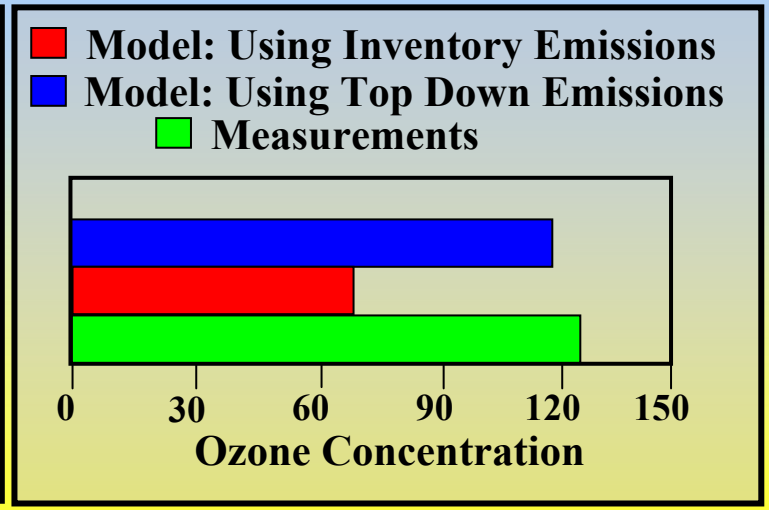
Approach: Analyze the chemistry and investigated the sources.


NO_x & VOCs
Ozone formation


Estimated from Measurements
Emissions Inventory
0
10
20
30
40
NO_x Emissions
0
20
40
60
80
VOC Emissions
Model: Using Inventory Emissions
Model: Using Top Down Emissions
Measurements
0
30
60
90
120
150
Ozone Concentration

Conclusions from Texas





- **Simple and well understood photochemistry reproduces ozone pollution in Houston.**
- **NOAA's top-down emission estimates uncovered substantial underestimates of VOC emissions in inventory tabulations.**
- **These VOCs are the source of Houston's most severe pollution.**

The "So What" Factor:

Texas has reassessed the emission inventories and revised the state air-quality implementation plans.

These revisions saved the industries in Texas nine billion dollars and sixty-four thousand jobs.

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Findings:

- **Measurements have showed that emissions of VOCs from biogenic sources can exacerbate ozone formation both rural and urban areas!**

- **NOAA has provided guidance for air-quality policy management of emissions from the Nation's electrical power generating system.**

- **NOAA's results have caused Texas to reassess its emission inventories and to revise the state air-quality implementation plans. These revisions saved the industries in Texas nine billion dollars and sixty-four thousand jobs.**