



PM Controls Findings from the 2016 AQMP White Paper

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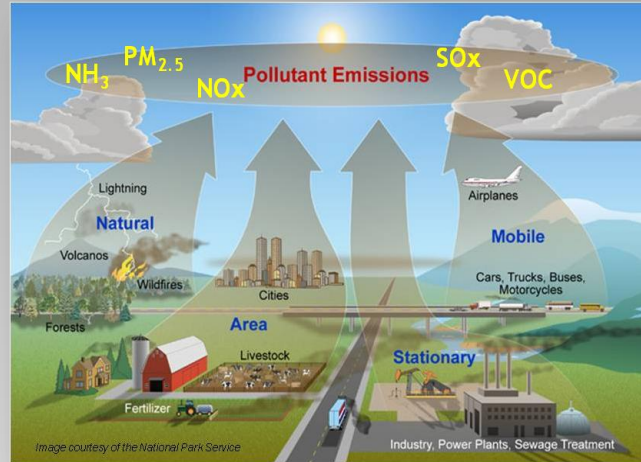
**2016 AQMP Control Strategy Symposium
June 11, 2015**

White Paper – PM Controls

- Scientific discussion
 - ❑ Pollutant formation
 - ❑ Precursors
 - ❑ Trends
- Paths to attainment: NO_x-heavy controls
- Recommendations on future control strategies
 - ❑ Maximize co-benefits
 - ❑ Time and place controls
 - ❑ Outreach and incentives
- Further studies

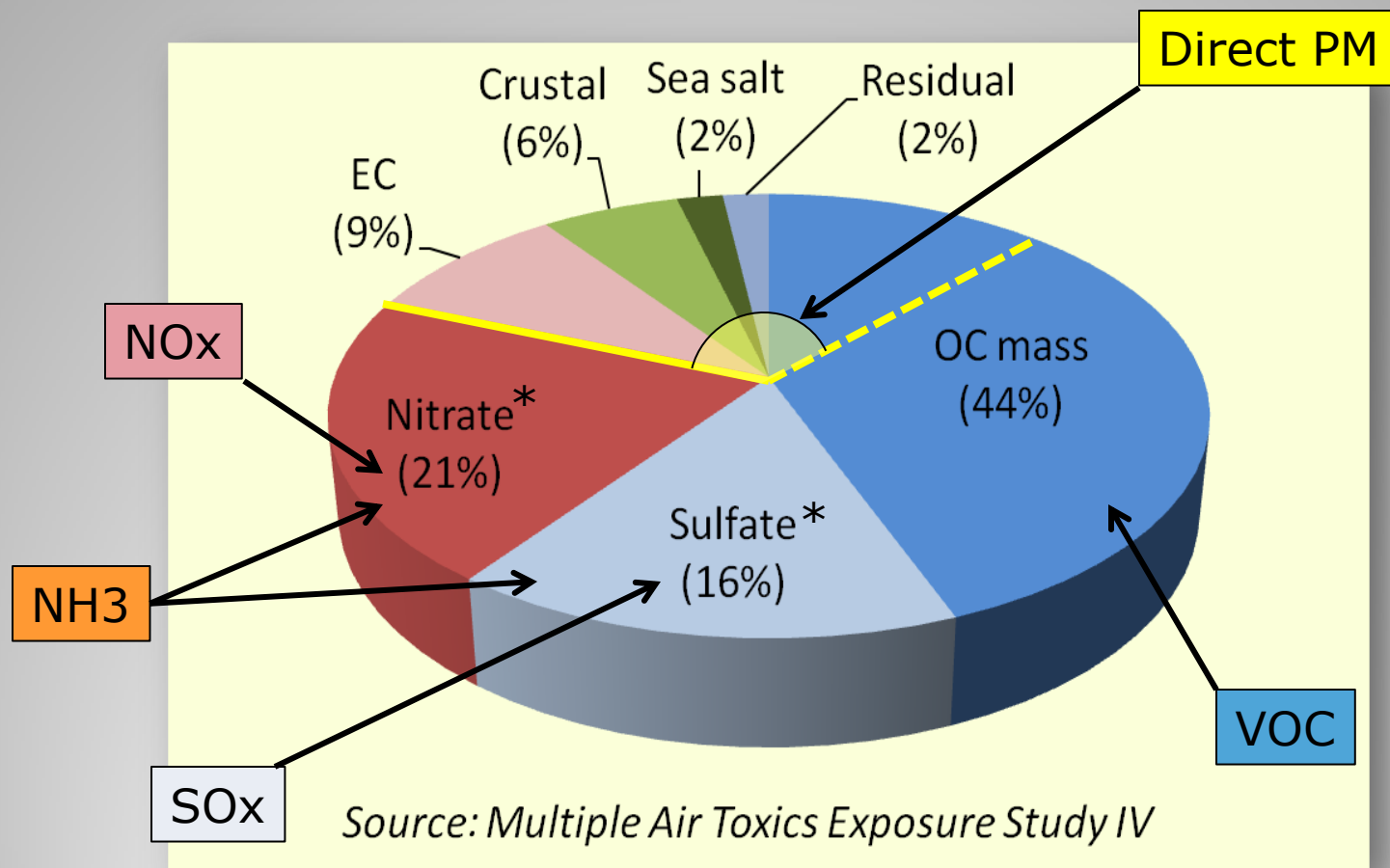


Particulate Matter Formation



- *Primary particles* – directly emitted (e.g., construction sites, unpaved roads, sea salt, abrasion, fuel combustion, cooking, fires)
- *Secondary particles* – photochemical reactions in the atmosphere (e.g., precursor gases transformed into solid or liquids)
 - ✓ NO_x + SO_x + ammonia = ammonium sulfate or ammonium nitrate salts
 - ✓ VOCs + atmospheric oxidants = secondary organic aerosol (SOA)
 - ✓ Secondary particles make up the majority of ambient PM_{2.5} in Basin

PM_{2.5} Chemical Profile



* Includes ammonium

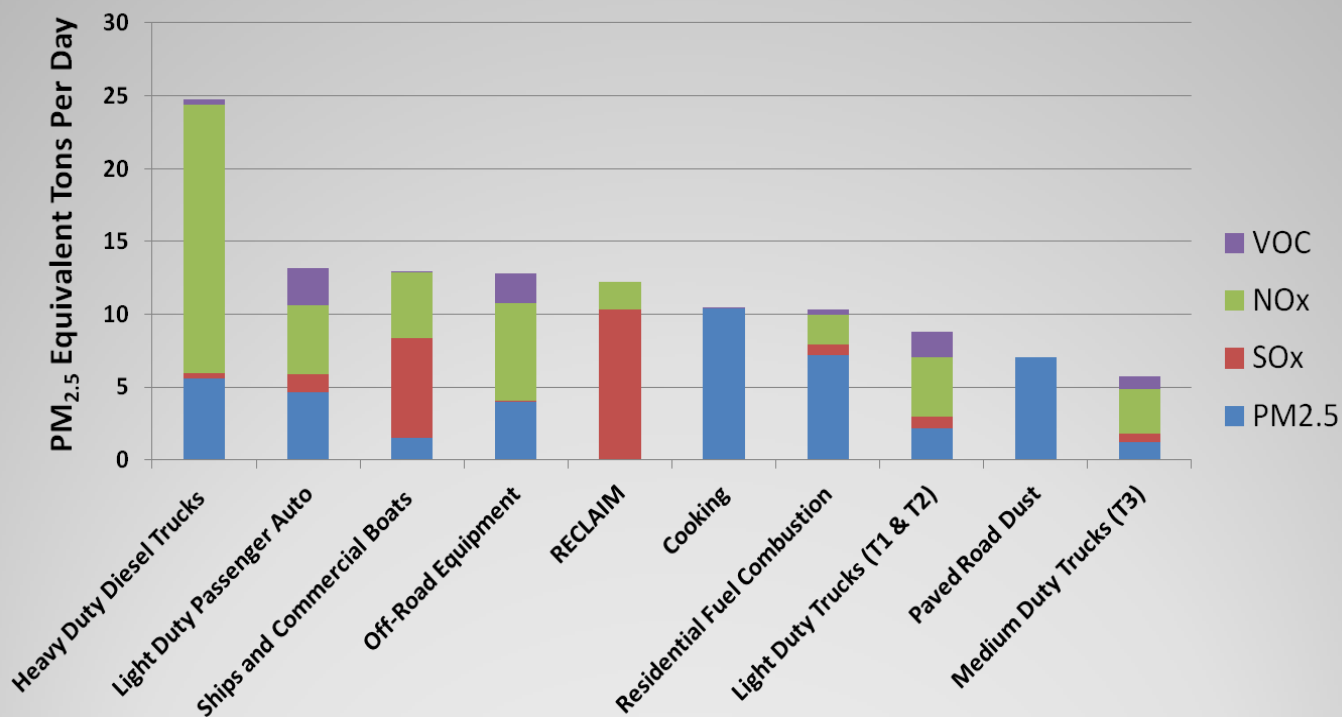
Direct (Primary) PM_{2.5} Top Emitters

Emission Sources	2012 Emissions (Tons/Day)
Commercial Cooking	10.4
Residential Fuel Combustion	7.2
Paved Road Dust	7.1
Heavy Duty Diesel Trucks	5.6
Light Duty Passenger Auto (LDA)	4.6
Off-Road Equipment	4.0
Wood and Paper	2.3
Light Duty Trucks (T1 & T2)	2.2
Construction and Demolition	1.7
Petroleum Refining	1.5

NOx Top Emitters

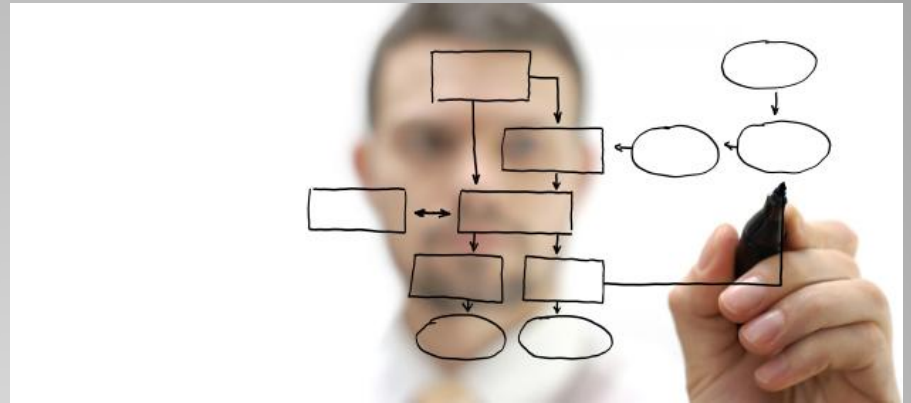
Emission Sources	2012 Emissions (Tons/Day)
Heavy Duty Diesel Trucks	184.1
Off-Road Equipment	67.0
Light Duty Passenger Auto (LDA)	46.8
Ships and Commercial Boats (OGV & CHC)	45.2
Light Duty Trucks (T1 & T2)	41.2
Medium Duty Trucks (T3)	30.2
Trains	21.3
Heavy Duty Gasoline Trucks	20.9
Residential Fuel Combustion	20.2
Heavy Duty Diesel Urban Buses (UB)	9.6

Emissions Categories Contributing to Annual PM_{2.5} Mass



* Based on 2016 AQMP – Baseline Annual Average Inventory for 2012

Integrated Path to Attainment



- Attainment paths for both ozone and PM_{2.5} call for heavy NO_x reductions augmented with limited, strategic VOC and PM_{2.5} controls

Geographic/Seasonal/Episodic Controls

- ✓ Cooking – Under-fired charbroilers
- ✓ Residential and Open Burning
 - Rule 445 - Expand trigger areas for Basin-wide no-burn days
 - Rule 444 – Alternatives to burning (mandatory chipping/grinding)
- ✓ Fugitive Dust – Enhanced street cleaning
- ✓ Ammonia
 - Dairies
 - Anaerobic Digesters

Recommendations: PM_{2.5}

Prioritized Approach

- 1) Co-Benefits from the Ozone NO_x Strategy
- 2) Co-Benefits from Climate Change or Air Toxic Control Programs
- 3) Outreach and Incentive Programs
- 4) Additional measures, including early-action measures, to ensure PM_{2.5} Attainment (direct PM_{2.5}, SO_x ammonia)