

VOC White Paper

Meeting #2

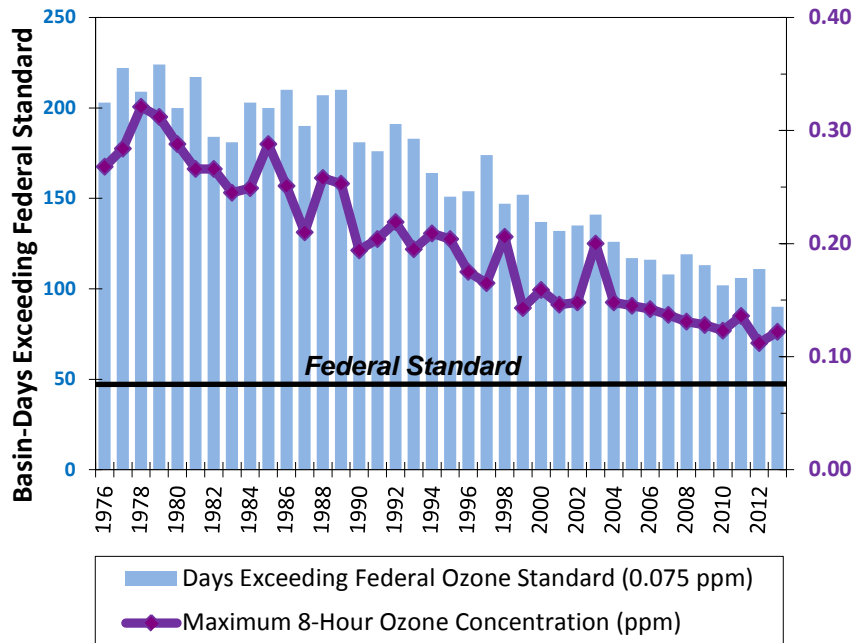
August 1, 2014

White Paper Overview

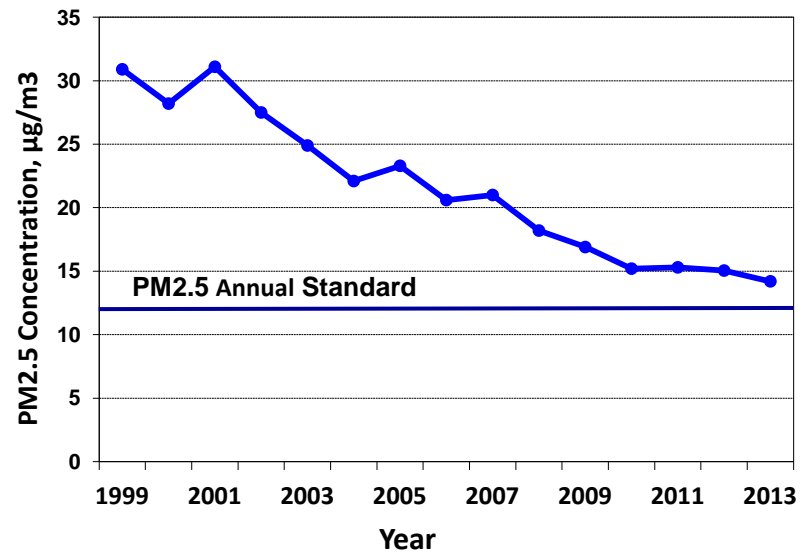
- Role of VOCs in ozone and PM_{2.5} formation
 - Technical analysis
 - Atmospheric chemistry
 - VOC to NO_x ratios
 - Major sources
- Implications of alternative strategies
 - Potential detrimental effects
 - Rationale for NO_x and VOC control strategy
- Potential approaches under consideration

Overall Goal: Attainment of Federal Standards

Ozone Trend



PM2.5 Trend



- Ozone
 - Current Standard 8-hour average – 75 ppb
 - Attain by 2032

- PM_{2.5}
 - Current Standard – 12 µg/m³
 - Attain by 2020-2025

Role of VOCs: Ozone Formation

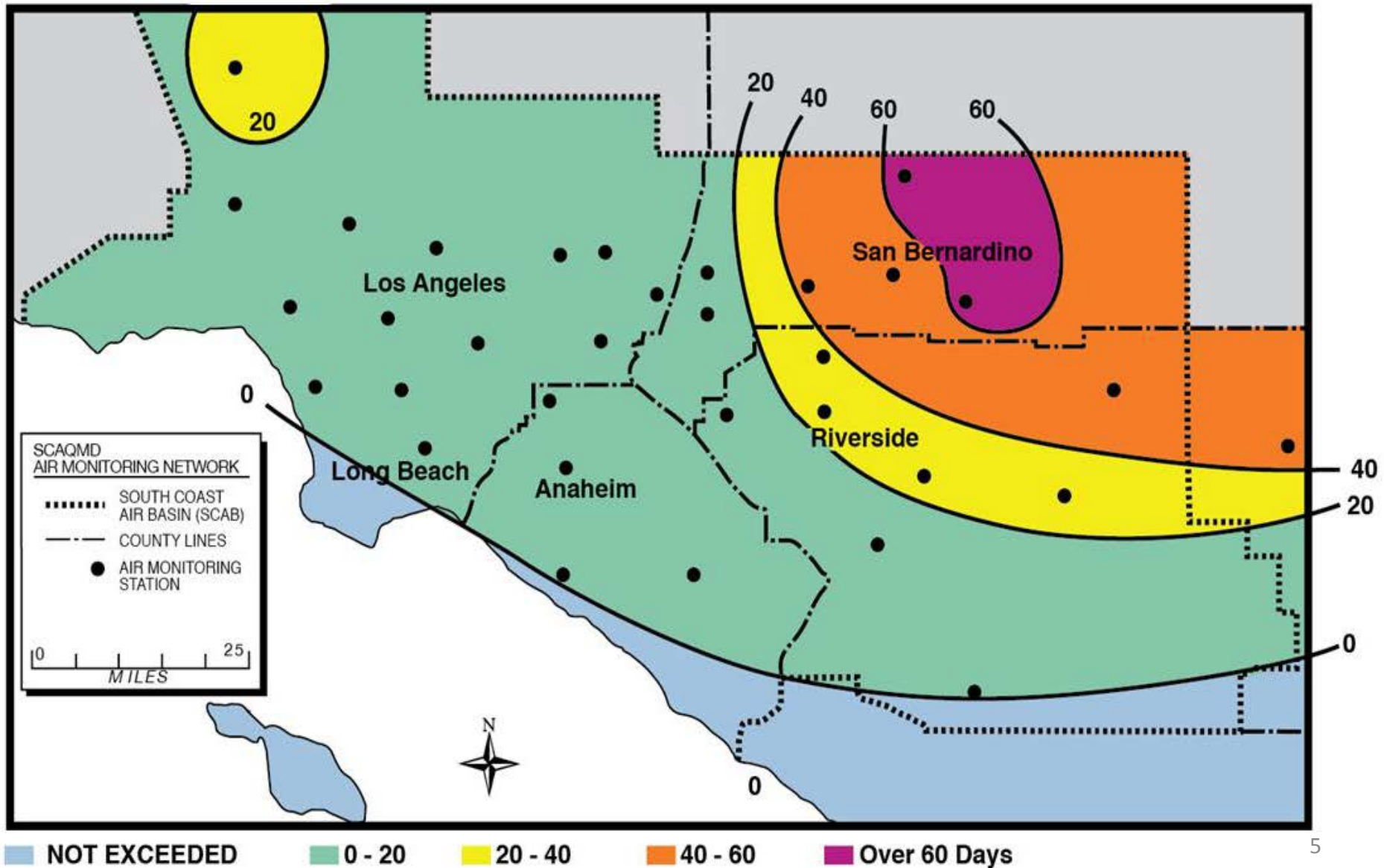
- Ozone levels a function of VOC/NOx ratios*
- NOx limited – decreasing NOx reduces ozone; decreasing VOC has little effect
- VOC limited – decreasing VOC reduces ozone; decreasing NOx has little effect or increases ozone

Region	VOC/NOx Ratio
Inland Empire/Mountains	NOx Limited
San Gabriel Valley	VOC Limited (Transitional)
Central Los Angeles	VOC Limited

*Many factors, including temporal and spatial, add complexity

OZONE – 2013

Number of Days Exceeding the Federal Standard
(8-hour average > 0.075 ppm)



Role of VOCs: PM Formation

- Primary Organic Aerosols
 - Science more developed
 - Typically from combustion (including mobile) sources
 - Does not account for significant portion of measured particulates
- Secondary Organic Aerosols (SOA)
 - Generated from the oxidation of organic gases in the atmosphere
 - SOA yield function of total organic PM available
 - More SOA produced in highly polluted environments
 - Higher carbon chain organics and aromatics form most SOA
 - Additional studies underway



Intermediate (I-VOC) and Semi-Volatile (S-VOC) Organic Compounds

- Organic compounds that occur in gas phase but may not be defined as VOC
- Form ozone
- Efficient Secondary Organic Aerosol (SOA) source
- May be significant emission source
 - Evaporation still occurs, but slower evaporation rate
 - Increases in temperature lead to significant enhancement in volatility
- Recent research completed on I-VOC and S-VOC
 - Likely to be significant source of SOA

Examples

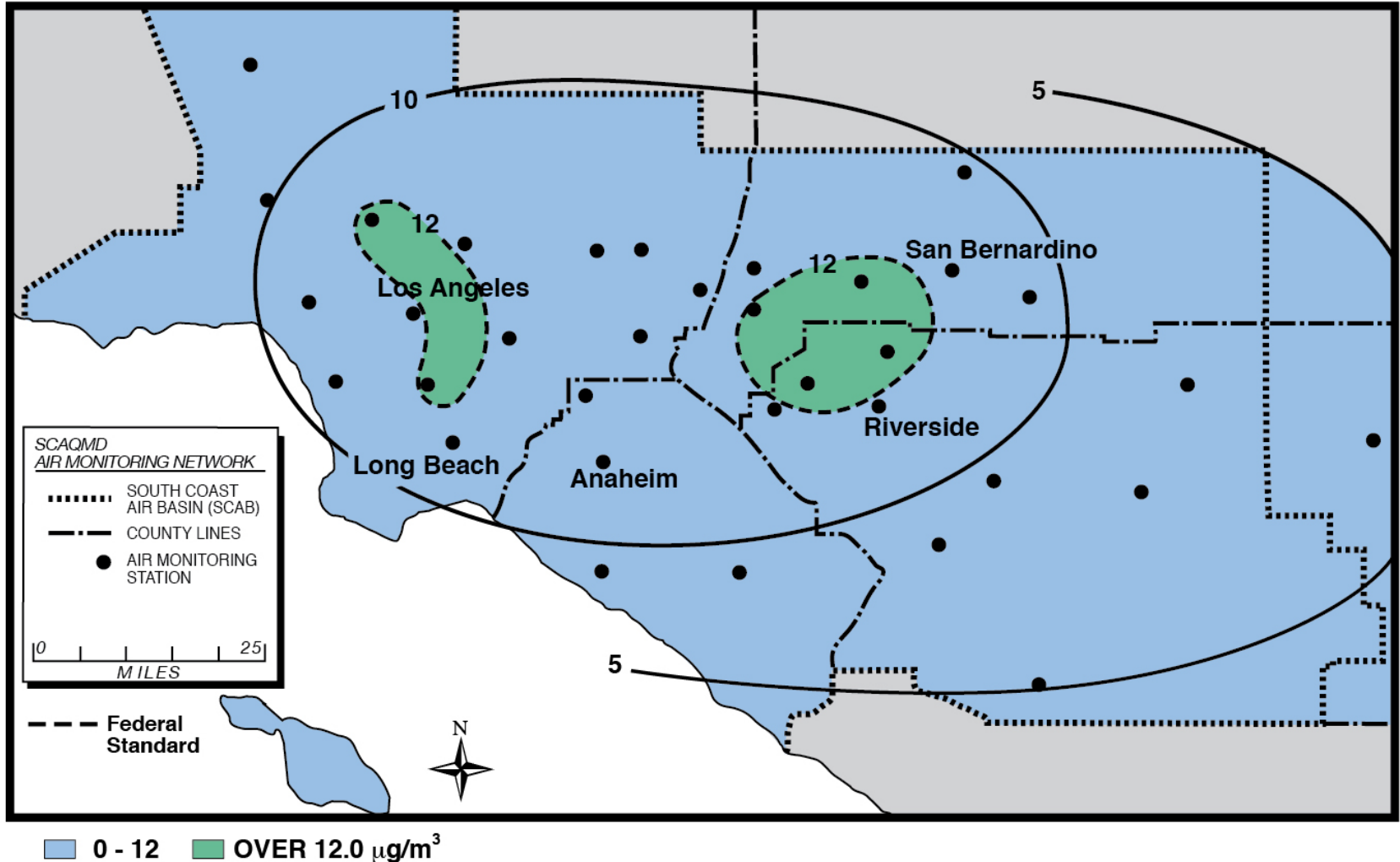
Intermediate (C12-C23) and Semi-Volatile (C24-C27) alkanes

Solvents used in coatings and adhesives

Low Vapor Pressure VOC consumer product solvents

PM2.5 – 2013*

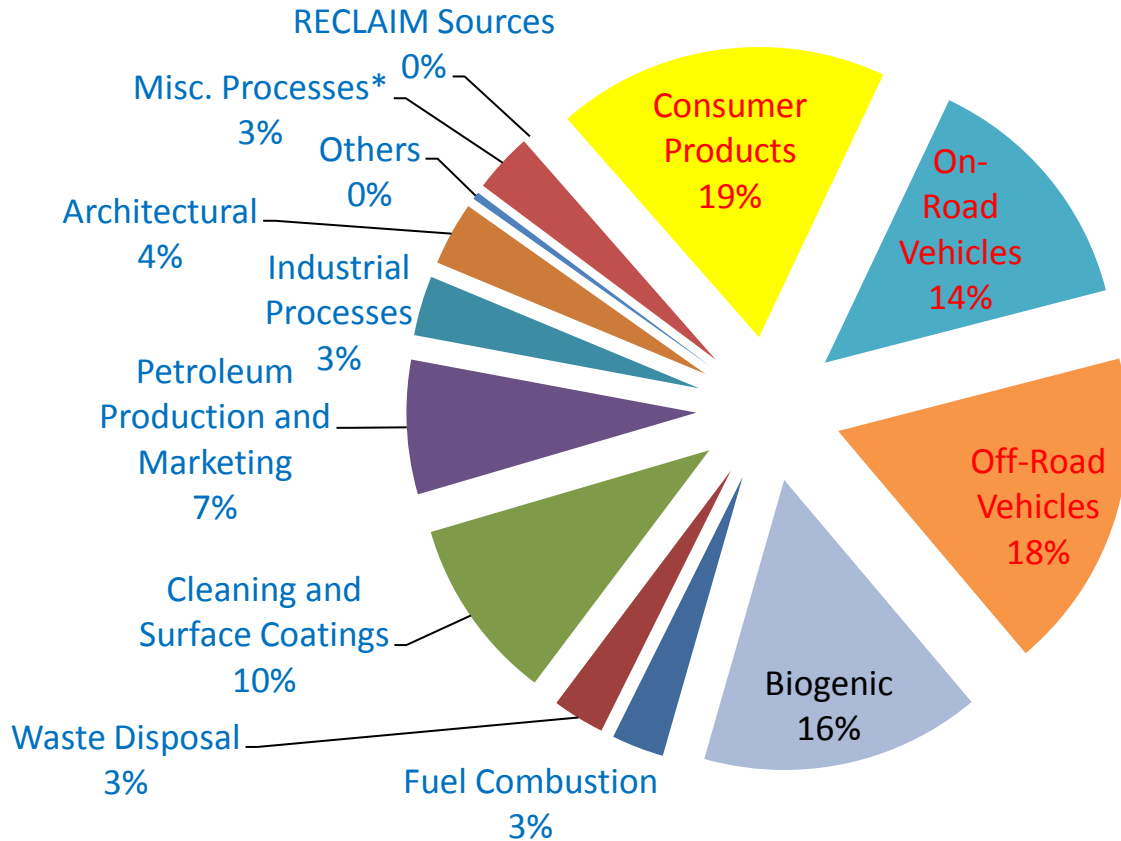
Annual Arithmetic Mean $\mu\text{g}/\text{m}^3$
(Federal Standard = 12.0 $\mu\text{g}/\text{m}^3$)



*Based on preliminary invalidated data.

VOC Sources* (2023)

Total = 481 tpd



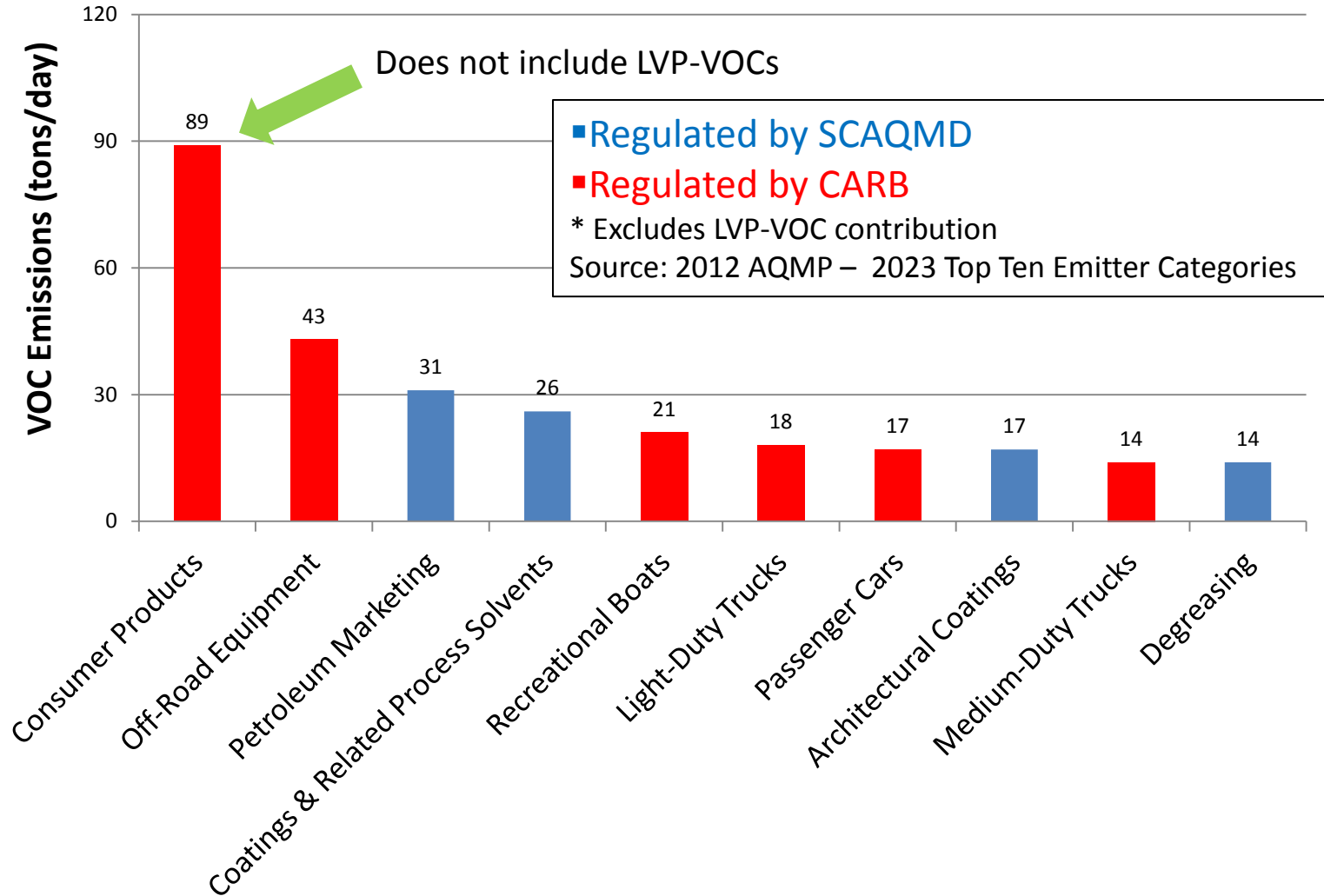
■ Regulated by SCAQMD

■ Regulated by CARB

* Excludes LVP-VOC contribution

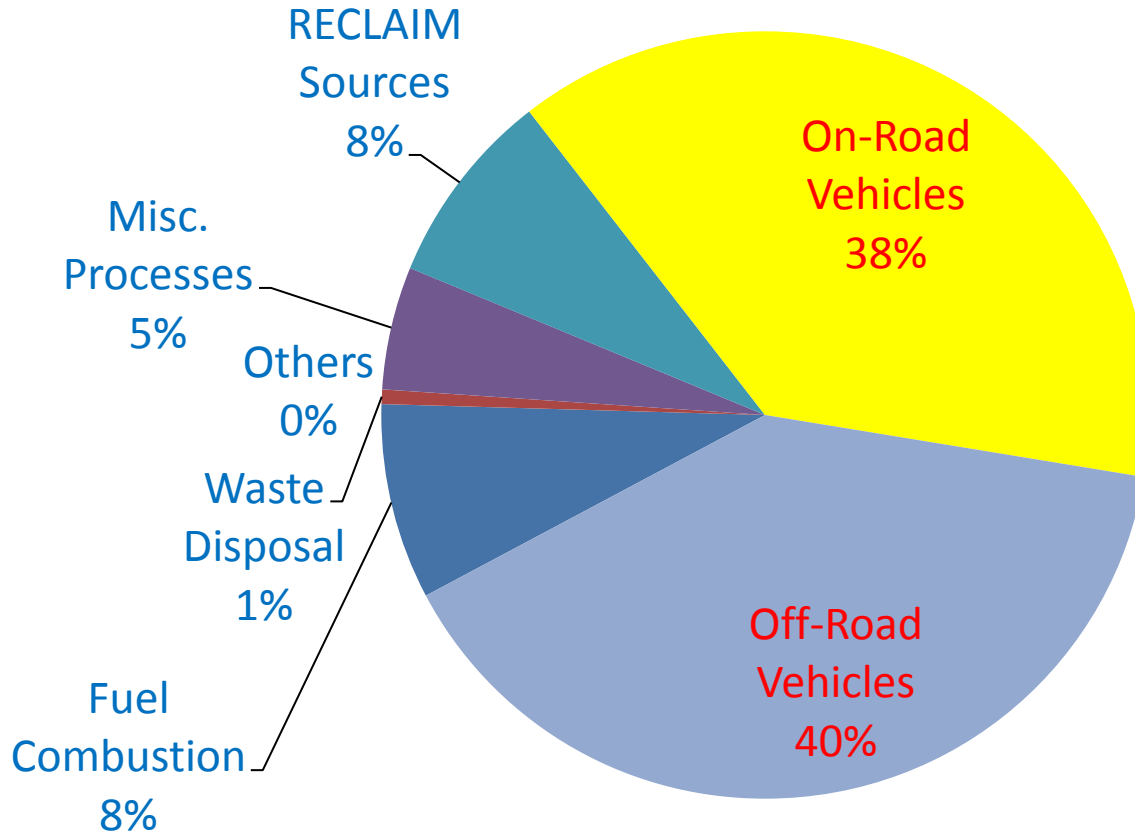
Source: 2012 AQMP – (excluding biogenic)

Top 10 VOC Source Categories*



NOx Sources (2023)

Total = 328 tpd

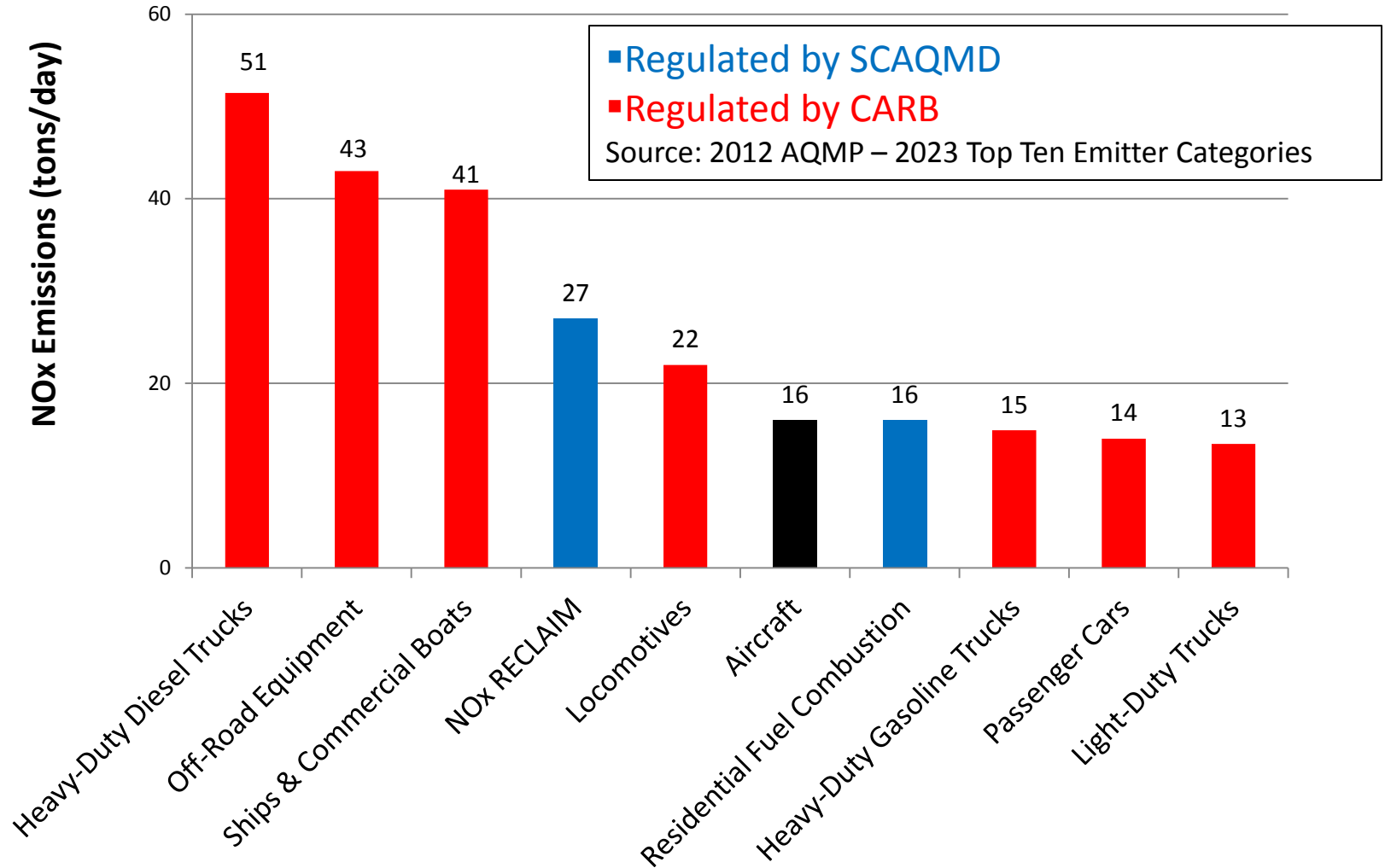


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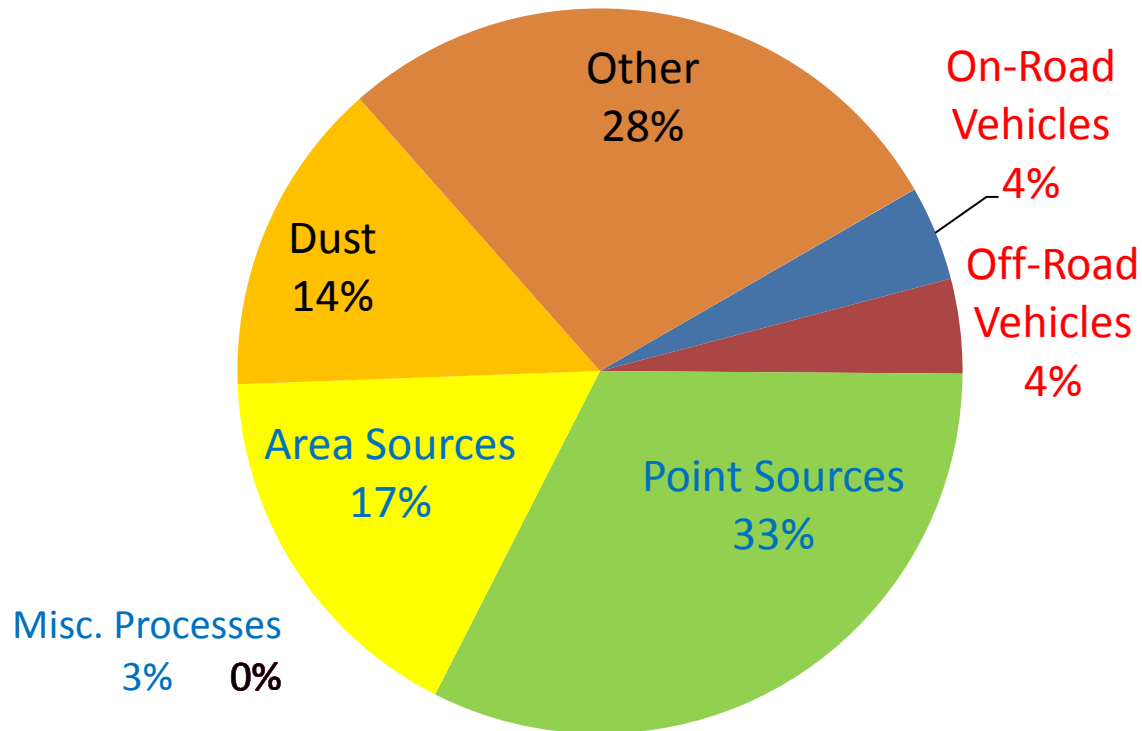
Source: 2012 AQMP

Top 10 NOx Source Categories



PM2.5 Sources* (2023)

Total = 71 tpd



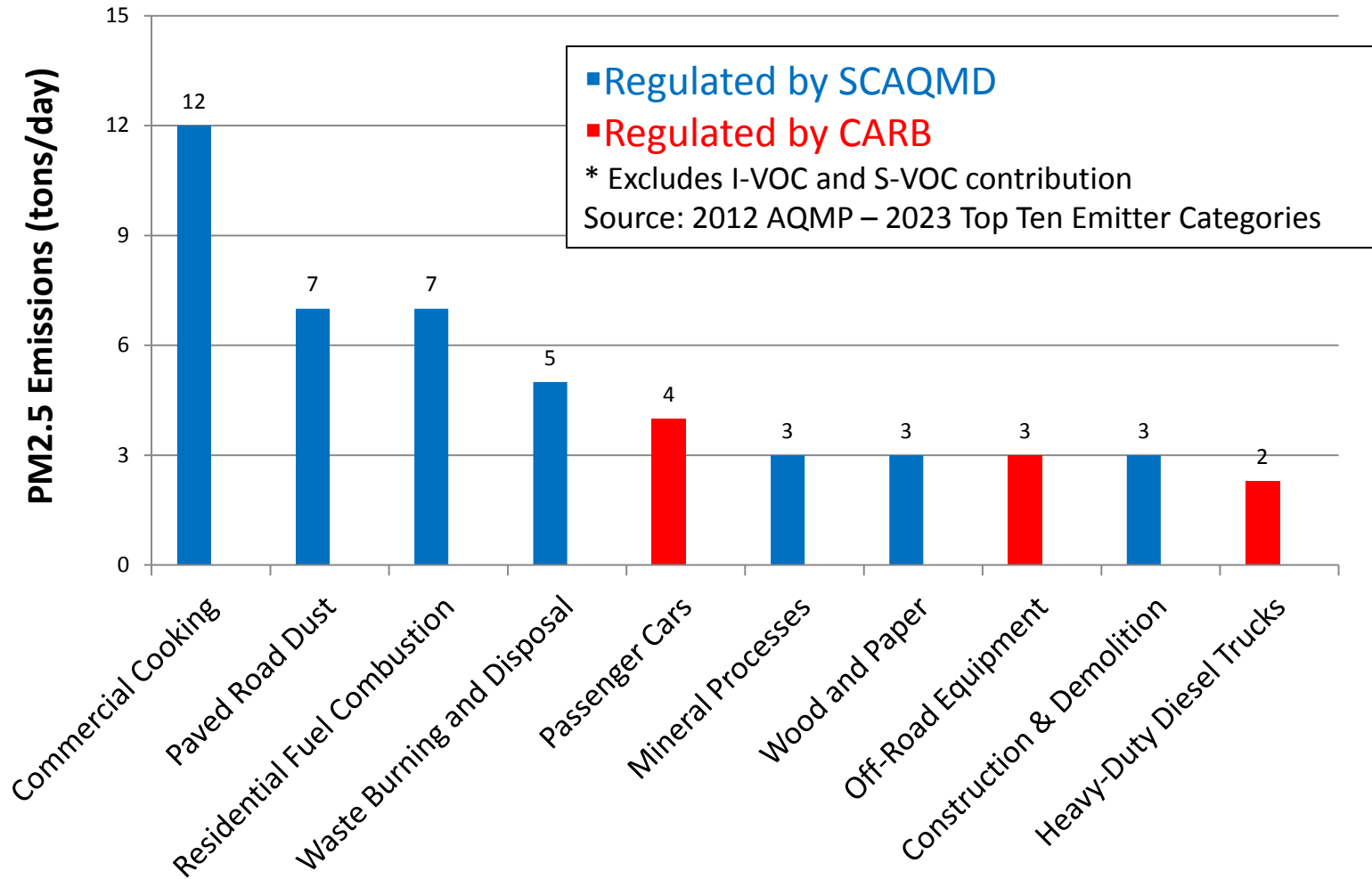
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* Excludes I-VOC and S-VOC contribution

Source: 2012 AQMP

Top 10 PM2.5 Source Categories



Implications of Alternative VOC Strategies

Strategy	Inland Empire & Mountains (NOx Limited)	San Gabriel Valley (VOC Limited)	Central Los Angeles (VOC Limited)
NOx Only	Ozone reduction; Limited PM reduction	Limited ozone increase; Limited PM reduction	Ozone increase; Limited PM reduction
VOC Only	Limited ozone reduction; Limited PM reduction	Ozone reduction; Limited PM reduction	Ozone reduction; Limited PM reduction
NOx & VOC	Ozone reduction; Enhanced PM reduction	Ozone reduction; Enhanced PM reduction	Limited ozone reduction; Enhanced PM reduction

Data Limitations

- Limited data on LVP-VOCs used in consumer products
- Intermediate and Semi-volatiles not included in inventories
 - VOCs from coatings/solvents/consumer products also may address additional uncertainty
- Some inventories are dated and rely on population and rule projections
- Smaller area source and consumer/institutional users do not normally report emissions
- Fugitive emissions and non-compliance difficult to estimate

Potential Approaches

- Sensitivity analysis to illustrate potential impacts
- Refine characterization of VOC sources
 - Product use surveys
 - Enhanced monitoring
- Temporal/Geographical
 - Utilize VOC/NO_x ratios opportunities
- Seasonality
- Incentives
 - Permit streamlining
 - Reduced record keeping
 - Recognition/Green Business-like program

Potential Schedule/Next Steps

- Release of Draft Paper – Aug 29, 2014
- Comments on Draft Paper – Sep 26, 2014
- Additional Working Group Meeting – As needed
- Final VOC White Paper – Late 2014

Backup Slides

VOC Sources (2023)

SOURCE CATEGORY	VOC (TPD)
Fuel Combustion	14
Waste Disposal	14
Cleaning and Surface Coatings	49
Petroleum Production and Marketing	36
Industrial Processes	16
Architectural	17
Others	2
Misc. Processes	16
RECLAIM Sources	0
Consumer Products	89
On-Road Vehicles	67
Off-Road Vehicles	86
Biogenic	75
TOTAL	481

■ Regulated by SCAQMD

■ Regulated by CARB

* Excludes LVP-VOC contribution

Source: 2012 AQMP – 2023 Baseline (excluding biogenic)

NOx Sources (2023)

SOURCE CATEGORY	NOx (TPD)
Fuel Combustion	27
Waste Disposal	2
Others	0
Misc. Processes	17
RECLAIM Sources	27
On-Road Vehicles	125
Off-Road Vehicles	130
TOTAL	328

■ Regulated by SCAQMD

■ Regulated by CARB

Source: 2012 AQMP – 2023 Baseline

PM Sources (Direct, 2023)

SOURCE CATEGORY	PM2.5 (TPD)
Fuel Combustion	6
Cleaning and Surface Coatings	2
Petroleum Production and Marketing	2
Industrial Processes	8
Solvent Evaporation	0
Misc. Processes	35
On-Road Vehicles	11
Off-Road Vehicles	7
TOTAL	71

■ Regulated by SCAQMD

■ Regulated by CARB

* Excludes Intermediate (C12-C23) and Semi-volatile (C24-C27) contribution

Source: 2012 AQMP – 2023 Baseline