Meeting PM2.5 Standards in the San Joaquin Valley

Public Workshop
Fresno, California

December 1, 2016

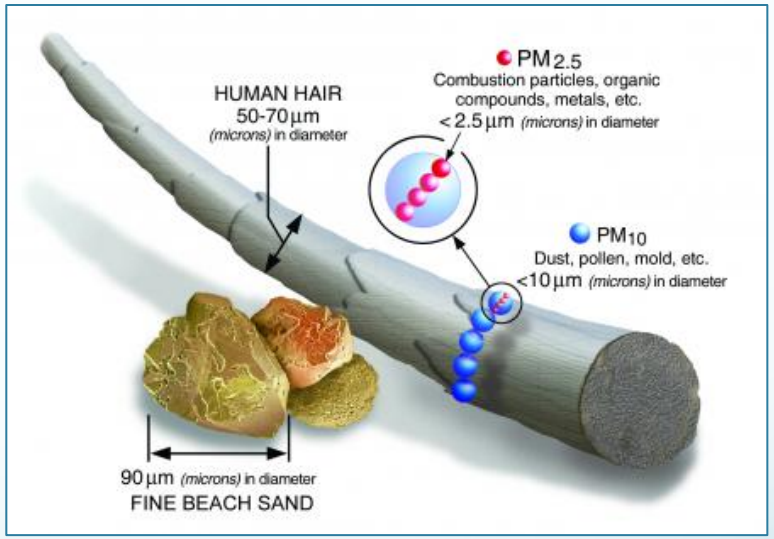
California Environmental Protection Agency
Air Resources Board

Today's Agenda

- Workshop Overview
- Nature and Sources of PM2.5
- Preliminary Air Quality Modeling
- Attainment Strategy
- Opportunities for Emission Reductions

What is PM2.5?

- Inhalable particles with a diameter 2.5 micrometers and smaller
- Can penetrate deep into the lungs and blood stream
- Mixture of many different chemical components
- Can be directly emitted as well as formed through reactions between gases



Health and Economic Impacts of Exposure to PM2.5

- Exposure to PM2.5 increases hospitalizations for respiratory and cardiac illness and exacerbates incidences of asthma attacks
- Results in approximately 1200 cases of premature mortality in the Valley each year
- Significant economic impacts from lost work days and health care costs

Board Direction on PM2.5 SIP

- Conduct additional public outreach on development of PM2.5 SIP for 12 ug/m3 annual standard
- Assess opportunities for further reductions from stationary and mobile sources
- Prioritize near-term reductions as part of overall attainment strategy
- Report back to Board in February with recommended actions

Focus of Today's Workshop

- Present science-based assessment of nature and sources of PM2.5 and how that informs strategy
- Present preliminary attainment strategy to address multiple PM2.5 standards
- Discuss opportunities for emission reductions and mechanisms to overcome barriers
- Subsequent workshops will focus on specific measure recommendations

Path to PM2.5 Attainment

- Integrated strategy for multiple standards
  - 35 ug/m3 24-hour
  - 15 ug/m3 annual
  - 12 ug/m3 annual
- Build on current progress under Clean Air Act
- Attainment achievable through combination of new ARB and District actions
- Include both regulatory and incentive-based approaches

District PM2.5 SIP Development Process

- District scoping meeting to discuss 2017 PM2.5 Plan on December 7, 2016
- Initiate Public Advisory Working Group
- Governing Board consideration in summer 2017

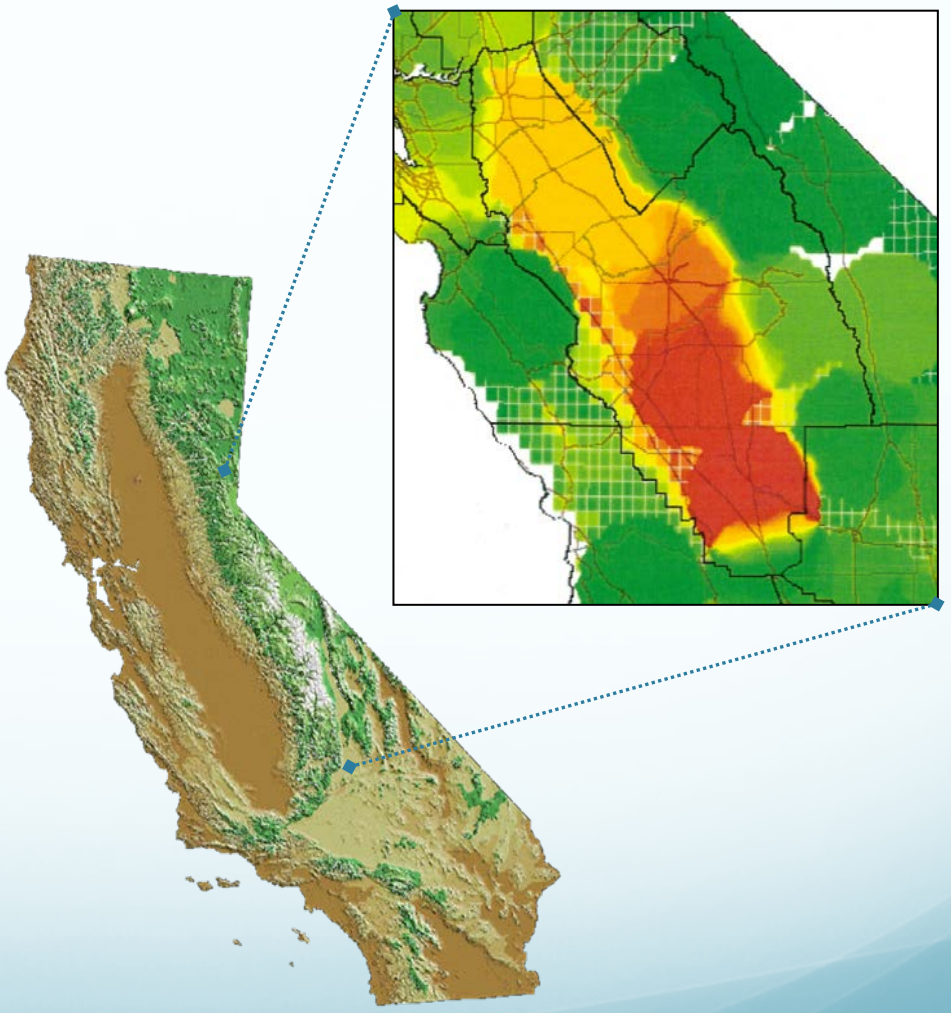
Nature and Sources of PM2.5

How Measurements and Inventory Inform the Attainment Strategy

- Magnitude and extent of current concentrations
- Seasonal variation in PM2.5 levels
- Chemical makeup of PM2.5 and contributing sources
- Regional and local contributions
- Progress due to implemented controls

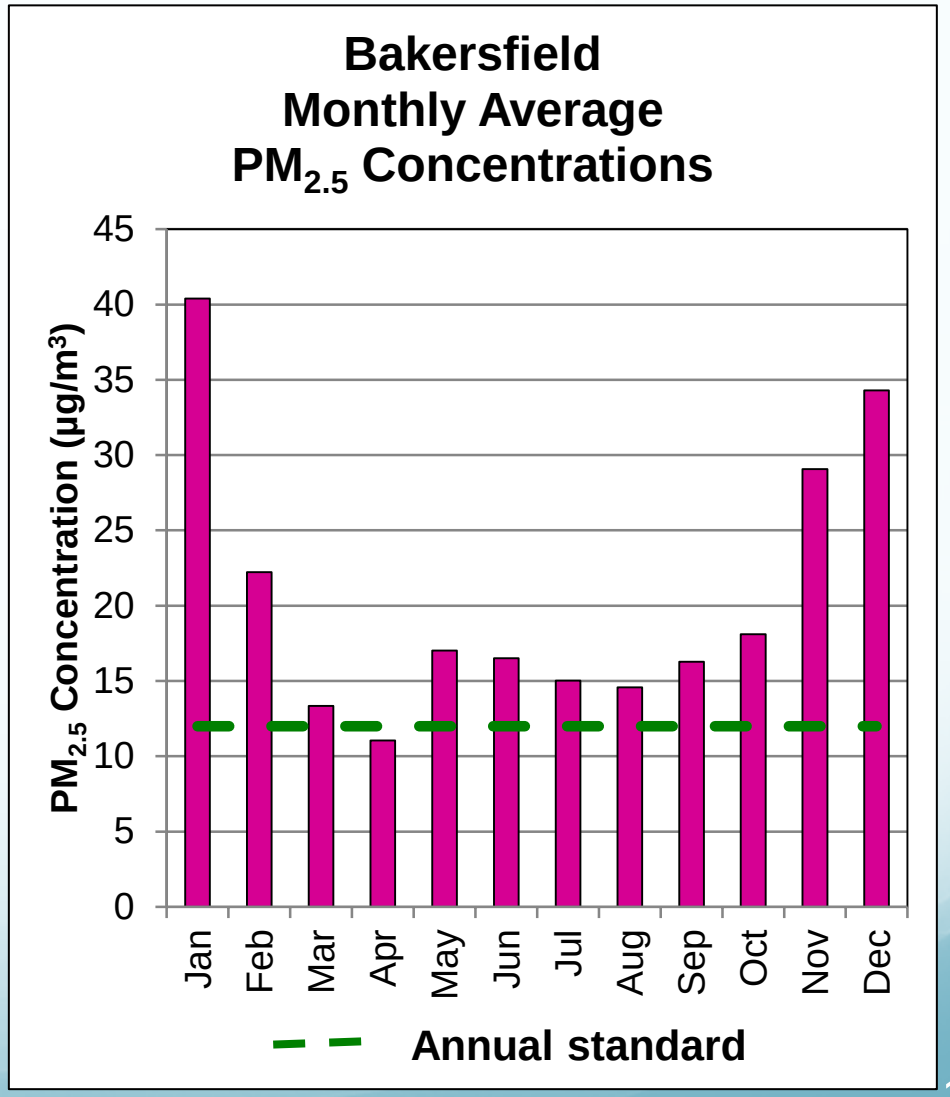
The Valley's PM2.5 Challenge

- Topography and weather conducive to formation and accumulation of PM2.5
- Weather conditions associated with drought have exacerbated challenge
- Highest levels measured in central and southern Valley

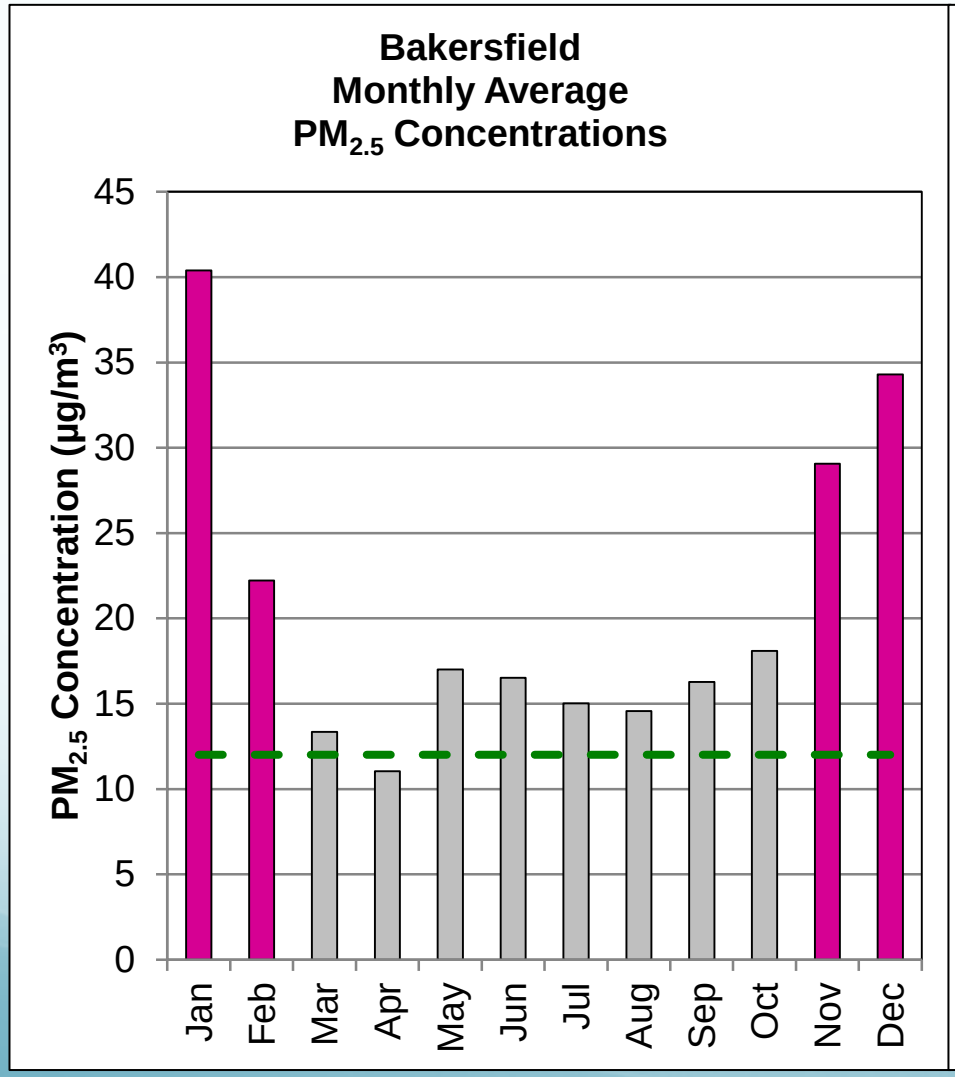


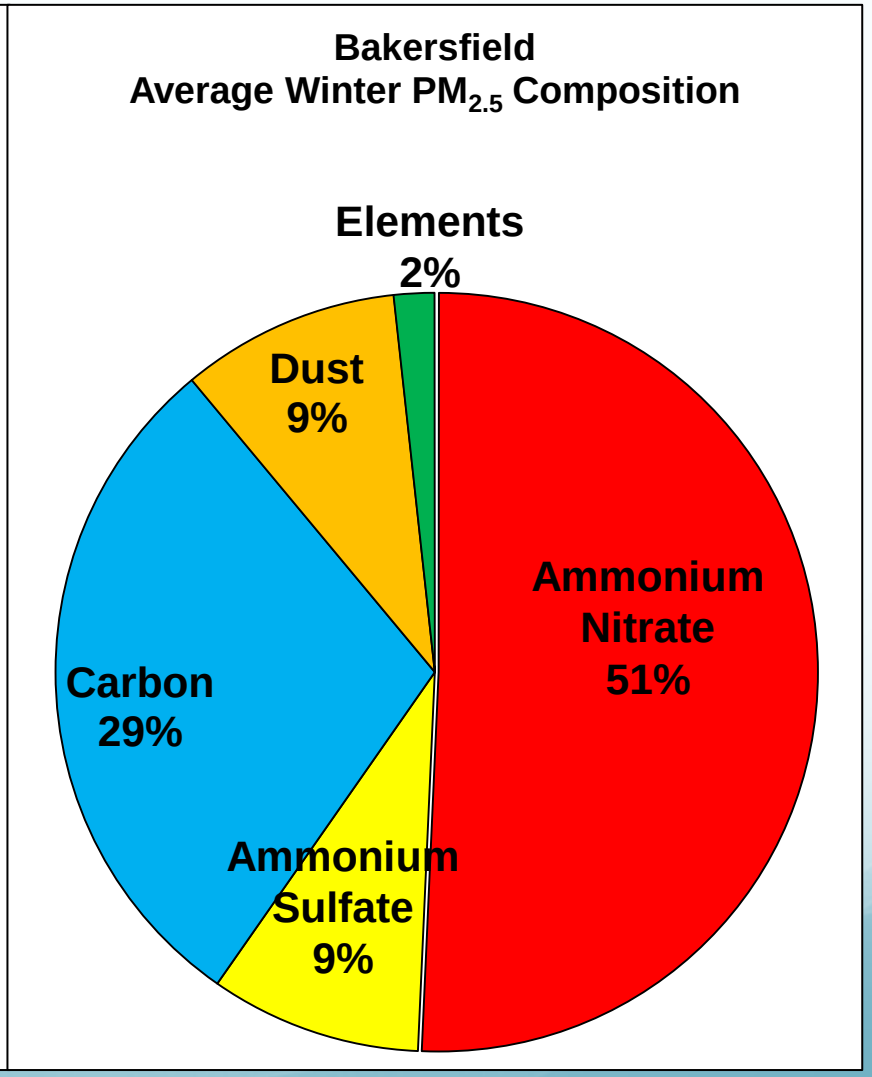
Need to Address PM2.5 Year-Round

- Highest levels during winter months
- Summer and fall also above annual standard
- Sources vary by season
- Requires year-round control strategy

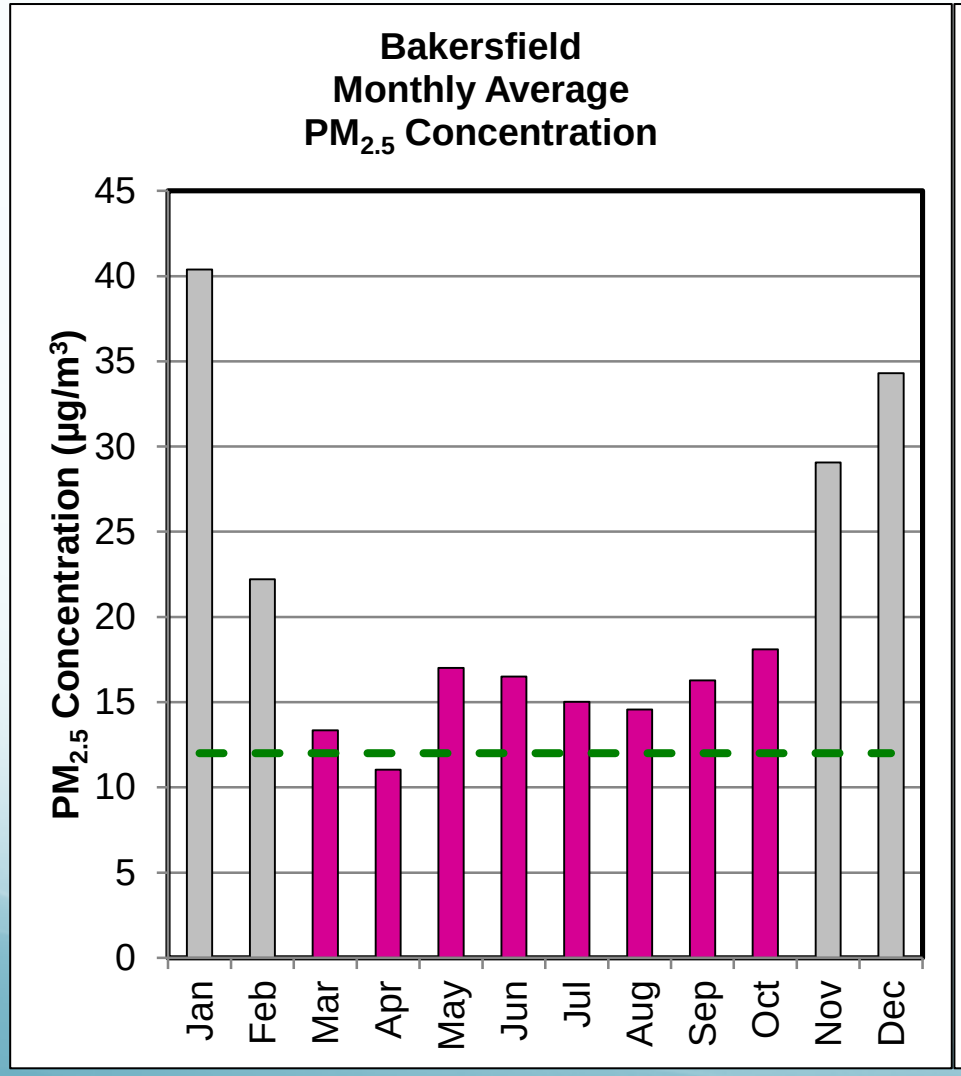


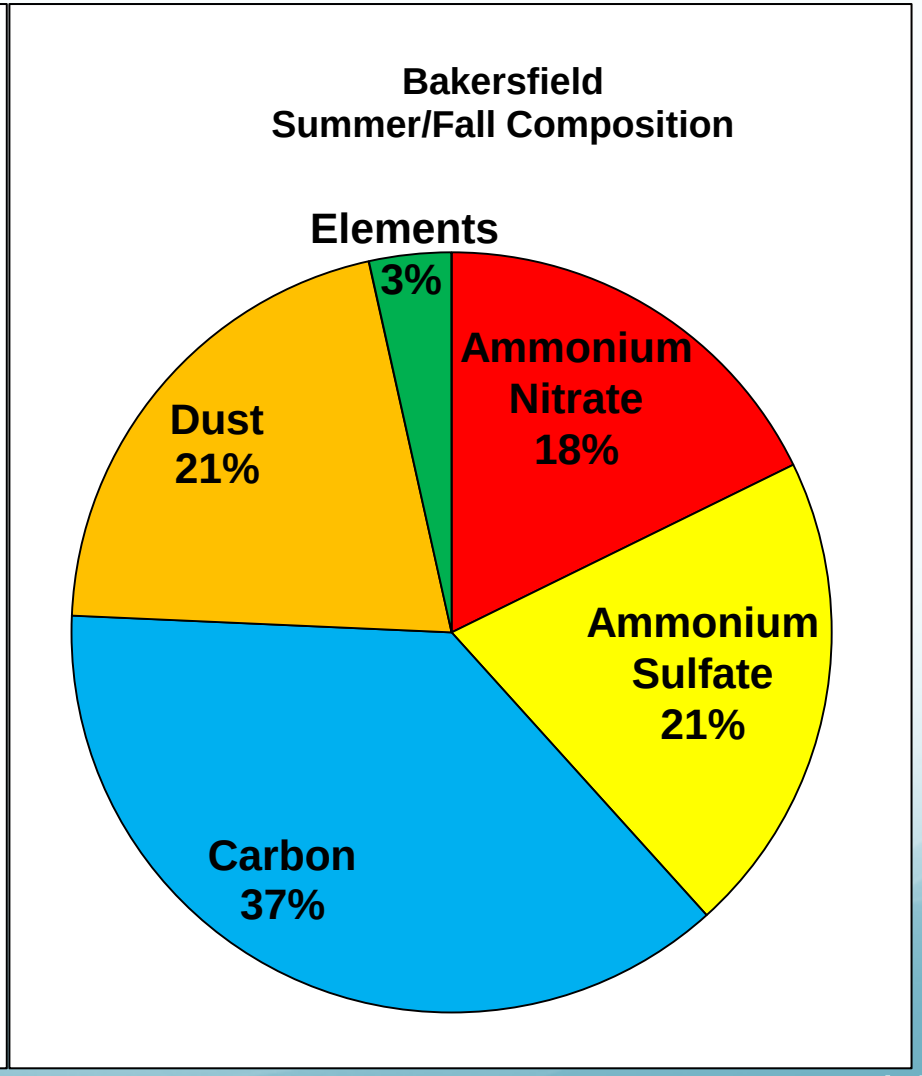
Winter Composition





Summer/Fall Composition

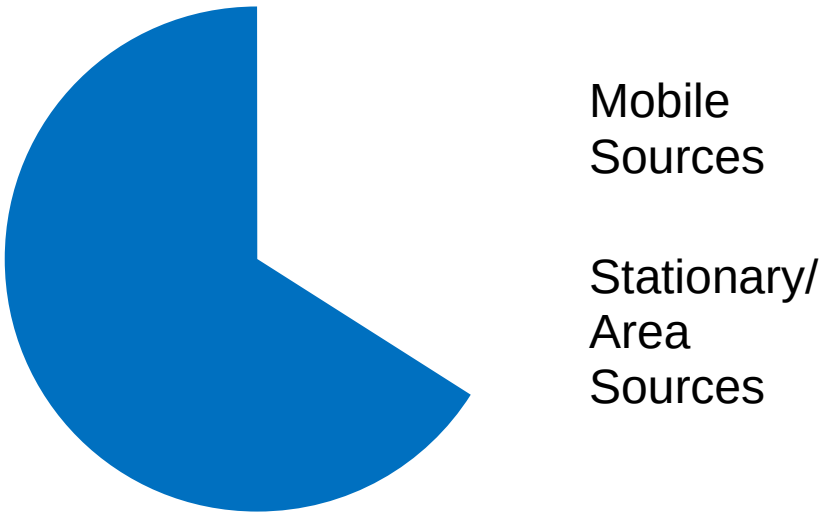




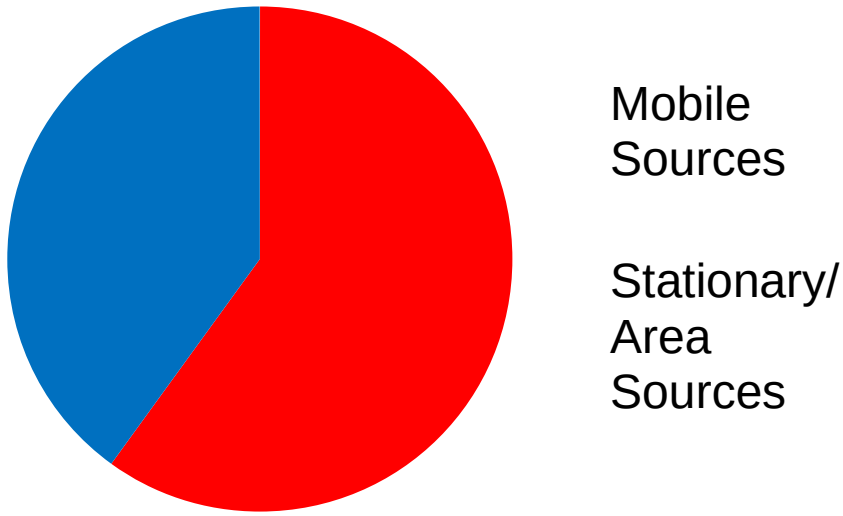
What are the Key Sources Contributing to PM2.5?

Both Mobile and Stationary Sources are Significant Contributors

Contribution to Annual Average



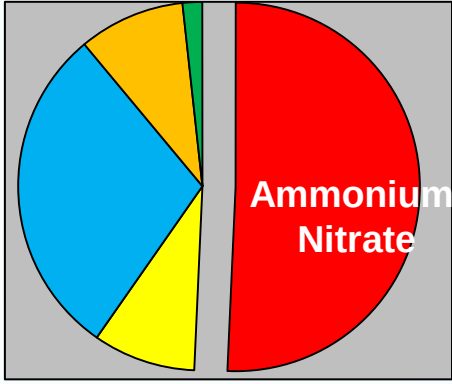
Contribution to 24-Hour Average



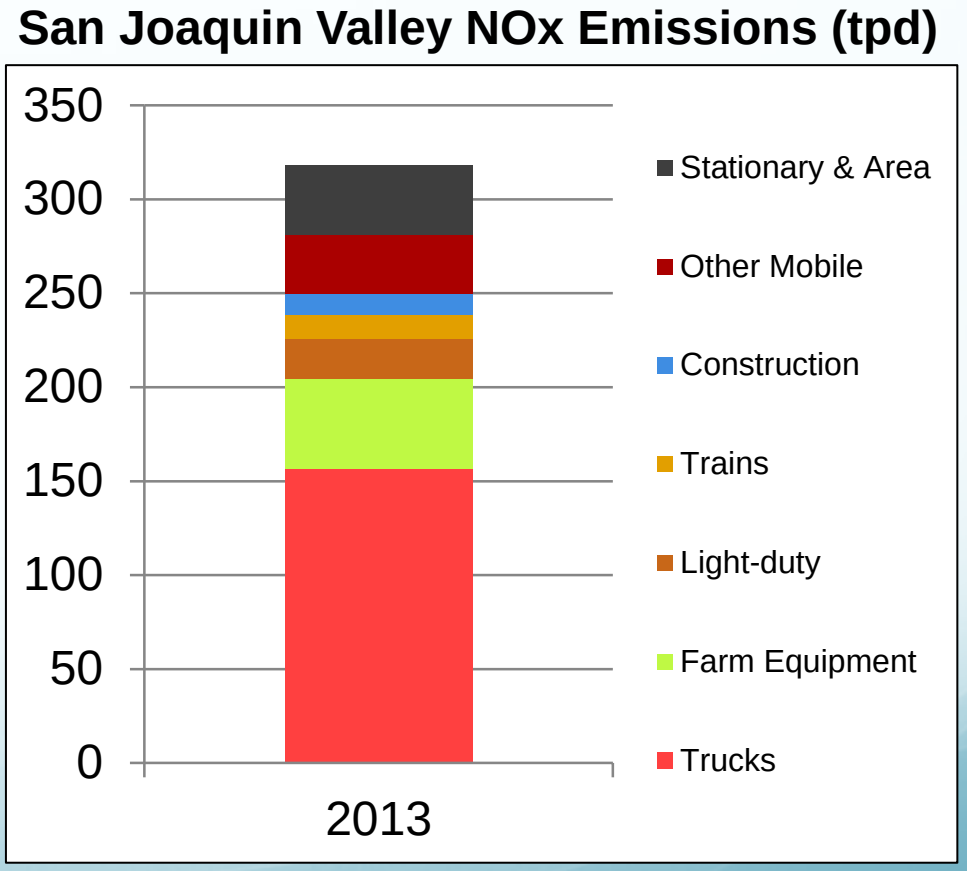
Mobile Sources: Includes cars, trucks, trains, planes, ships, tractors, construction equipment, forklifts, and other off-road equipment

Stationary/Area Sources: Includes industrial sources, wood burning, dust, commercial cooking, ag and forest burning, and residential and commercial fuel use

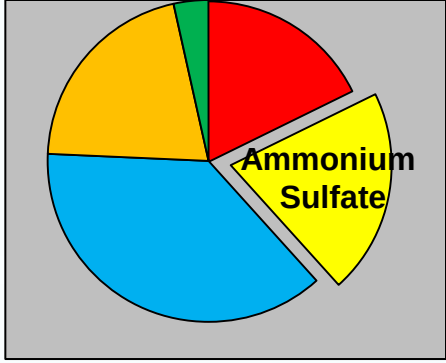
Ammonium Nitrate Sources



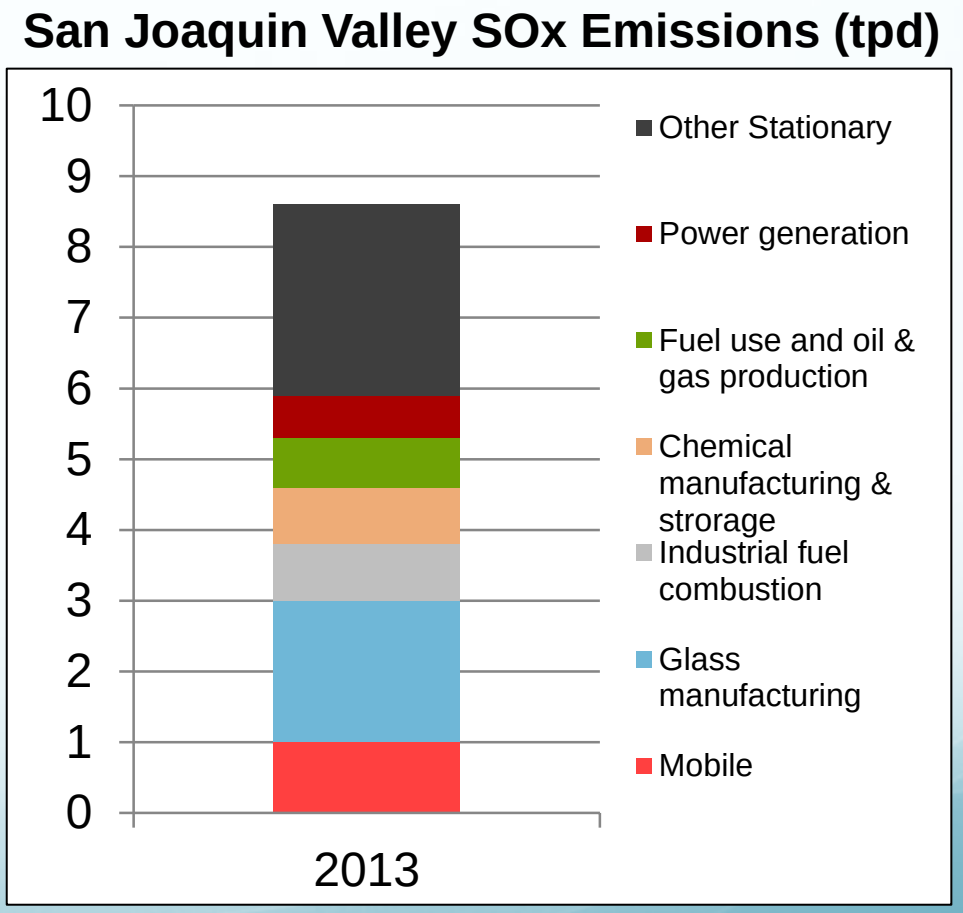
- Winter weather conditions conducive to formation
- NOx controls most effective in reducing ammonium nitrate levels



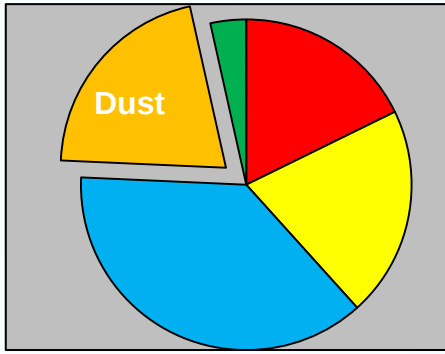
Ammonium Sulfate Sources



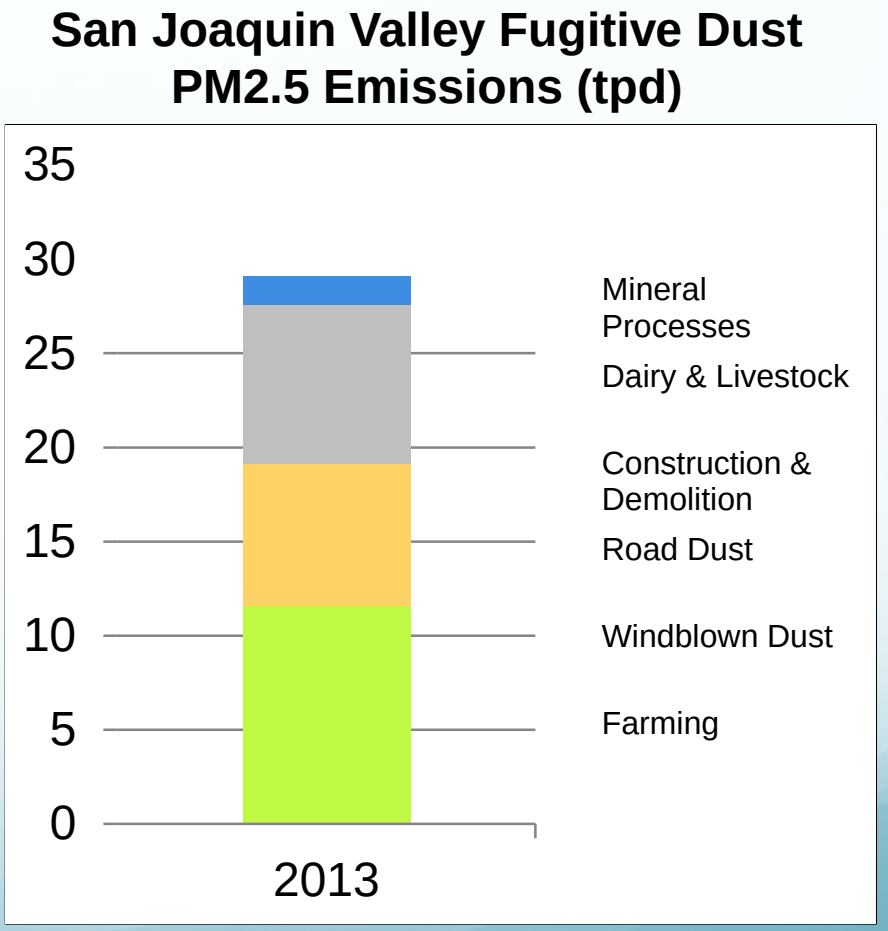
- Summer weather conditions most conducive to formation
- Large number of small sources



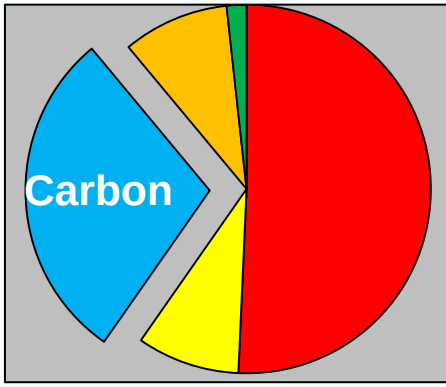
Fugitive Dust Sources



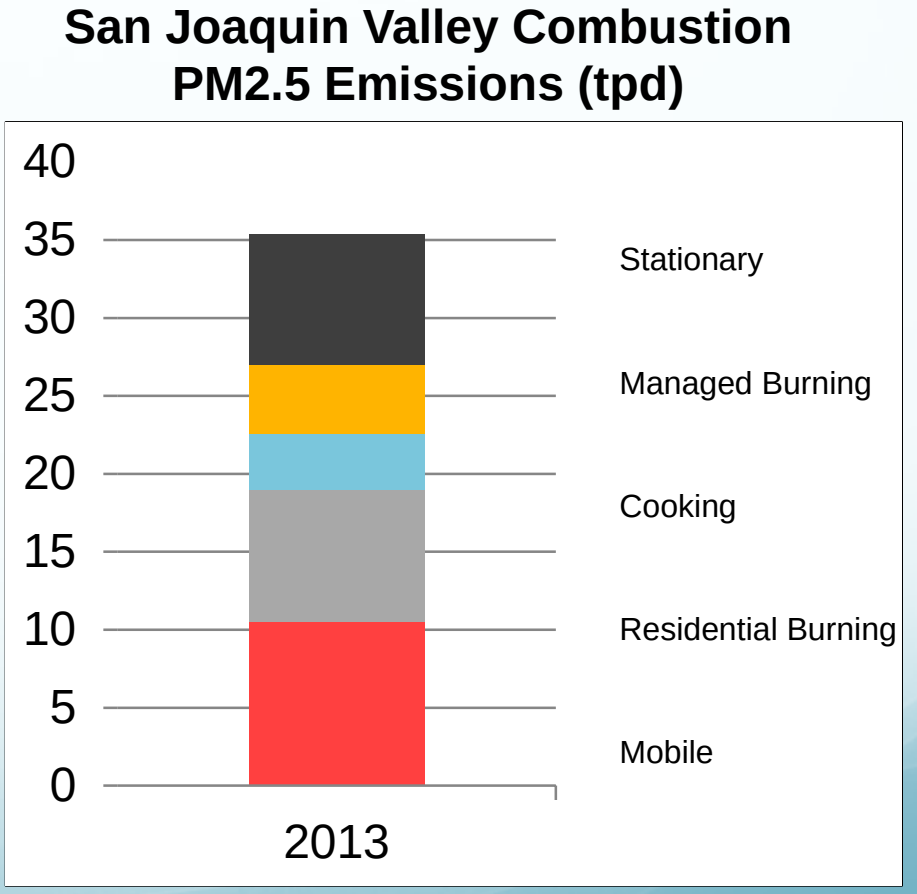
- Largest contribution in summer and fall
- Fallow fields and drier soils in recent years have increased dust fraction
- Contributions are more local in nature



Combustion Carbon Sources

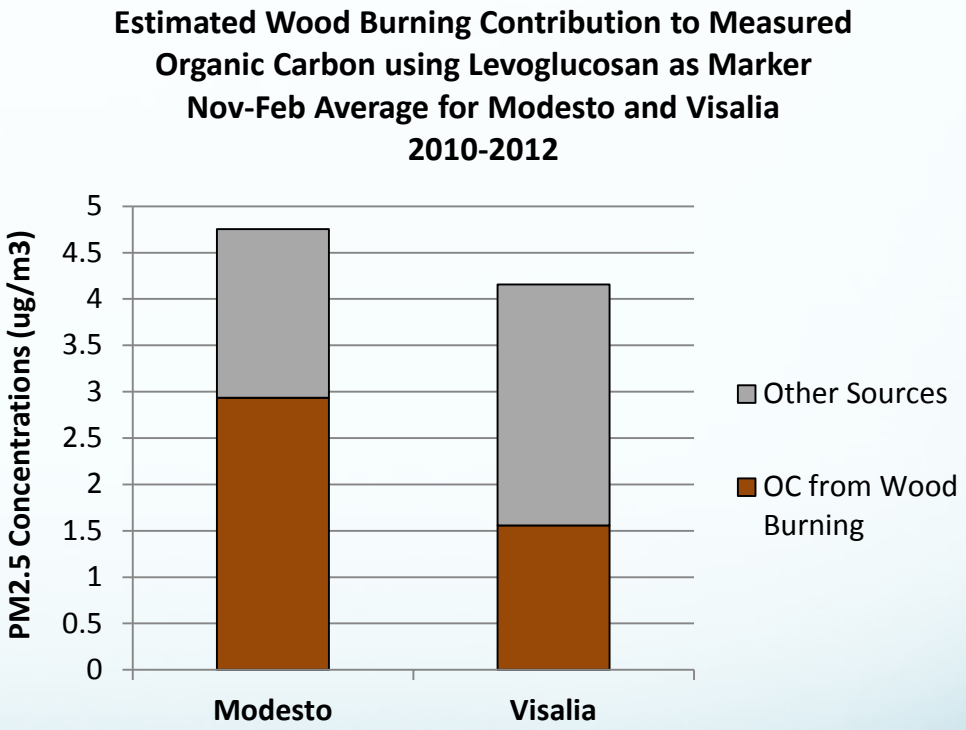


- Primarily directly emitted combustion particles
- Contributions are more local in nature
- Chemical markers also help identify sources

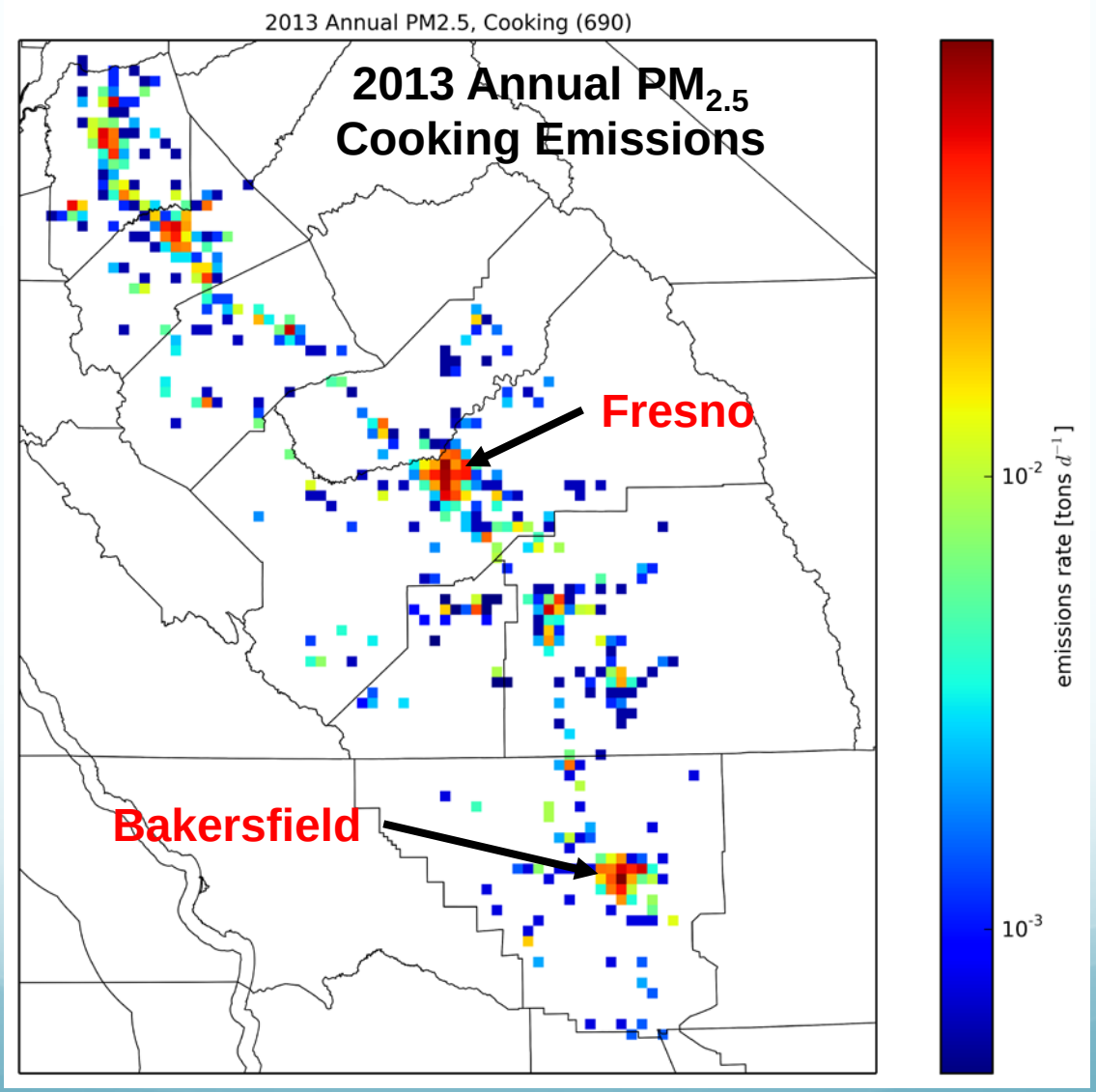


Chemical Markers Identify Wood Smoke Contribution

- Levoglucosan formed during high-temperature combustion of biomass
- Useful in apportioning fraction of organic carbon from wood smoke
- Demonstrates wood smoke comprises 30 to 60 percent of measured carbon during the winter

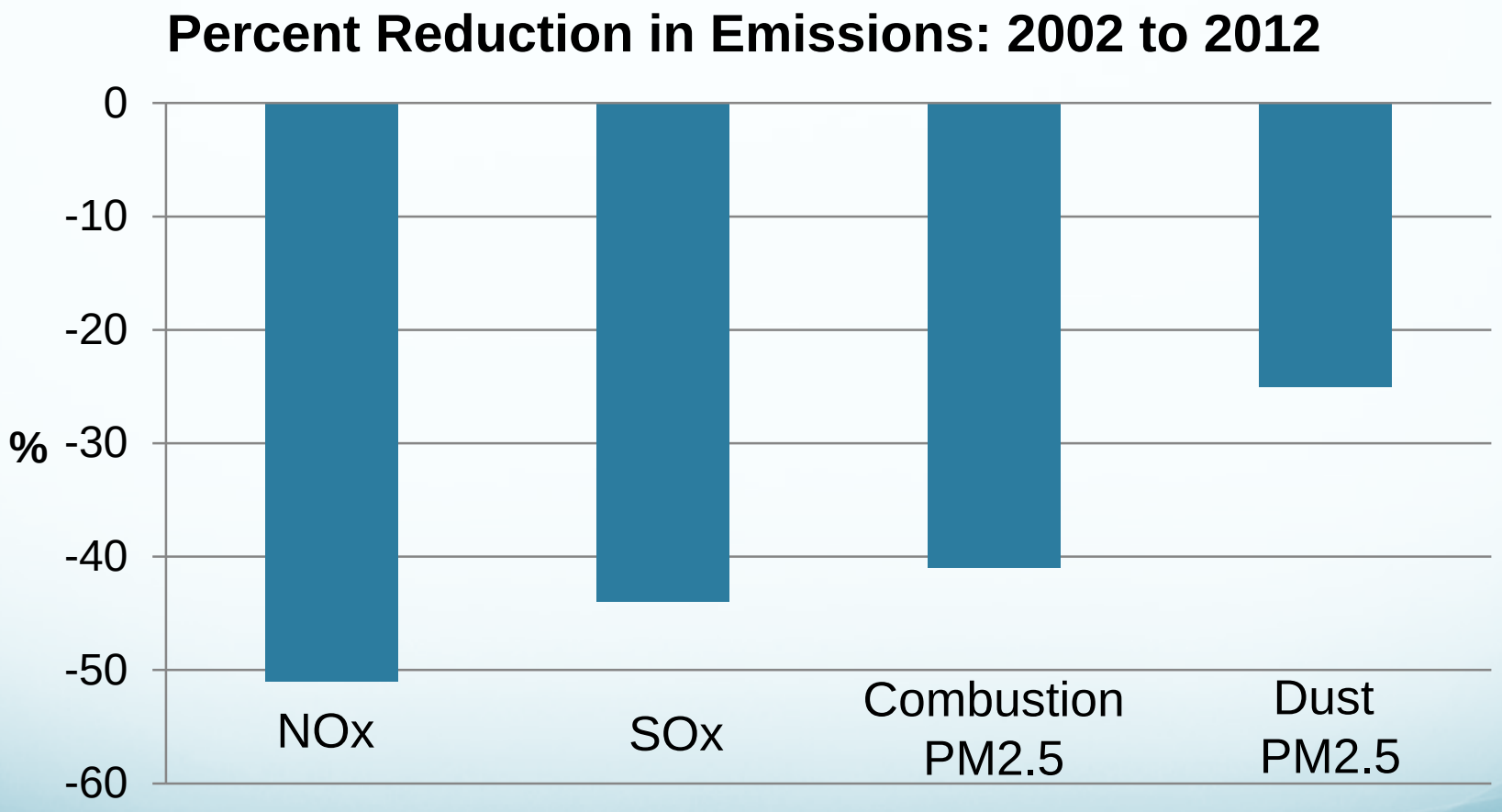


Sources Can Have Different Localized Impacts

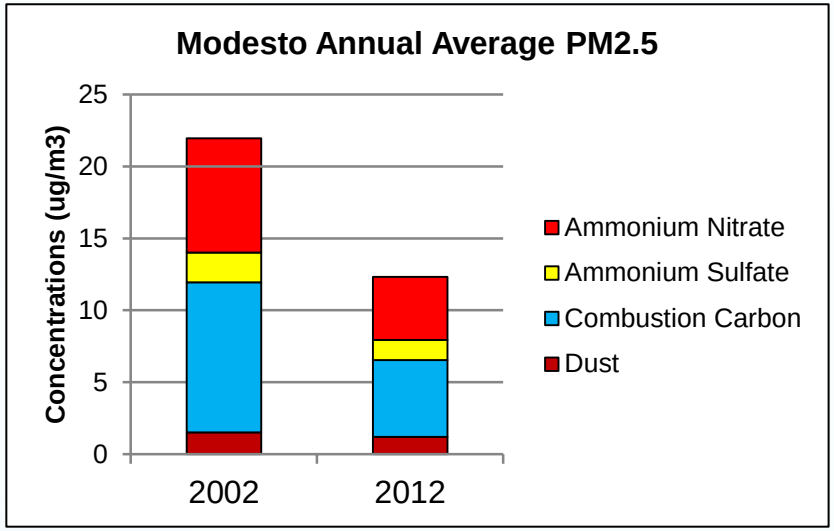


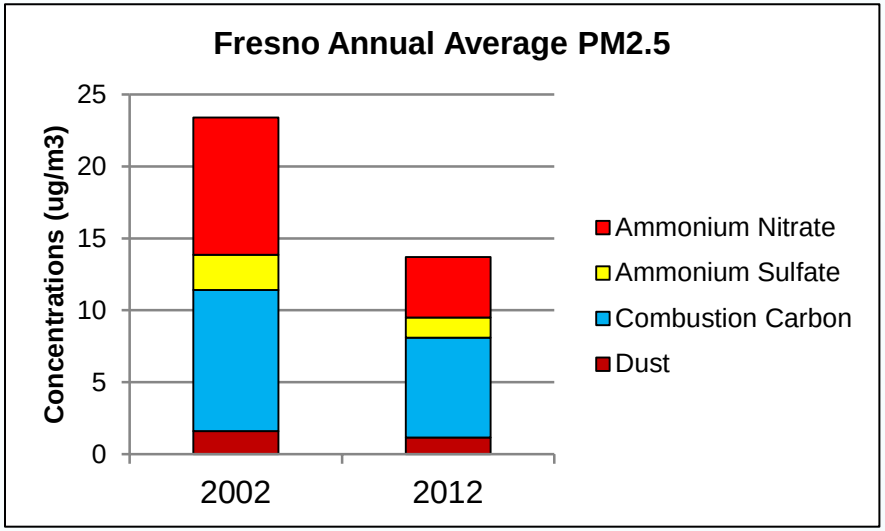
What are the Benefits of Emission Reductions to Date?

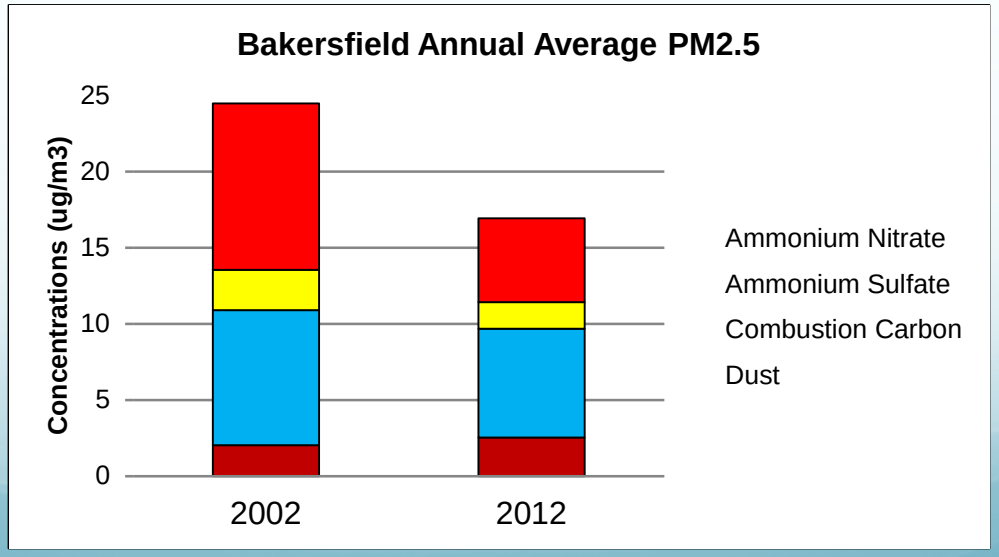
Ongoing Progress in Reducing Emissions



Reductions in NOx and Combustion PM2.5 Emissions Have Been Effective







Key Findings

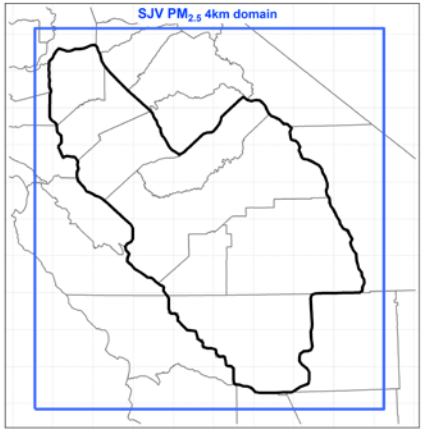
- Multiple constituents contribute to measured PM2.5 levels throughout the year
- Both stationary and mobile sources are significant contributors
- Both regional and local scale emissions impact PM2.5 levels
- Reductions in NOx and directly emitted PM2.5 emissions have been effective

Preliminary Air Quality Modeling

How Air Quality Modeling Informs the Attainment Strategy

- Links changes in emissions to changes in future air quality
- Informs control strategy approach:
  - Relative effectiveness of reductions in individual precursors
  - Relative contribution of sources
  - Sensitivity to reductions from specific sources
- Establishes attainment targets

Modeling Approach



- Utilizes the latest peer-reviewed science
- Consistent with U.S. EPA Guidance
- Model base (2013) and future (2025) years
  - Reflects weather conditions associated with drought
  - Includes DISCOVER-AQ (NASA) field campaign from Jan 10 – Feb 10, 2013
- Modeling results used in a relative sense (Relative Response Factor)

What Further Emission Reductions are Included in the Modeling?

Current Control Programs Provide Significant New Reductions

- Will reduce NOx an additional 50 percent and PM2.5 an additional 5 percent by 2025
- Continued implementation of truck and bus regulation through 2023
- New passenger vehicle standards
- Curtailment programs and replacement of fireplaces and wood stoves
- Cleaner agricultural IC engines
- Over $400 million public/private investment in tractor replacements

Annual NOx Emissions:
Benefits of Current Control Program

	2013 (tpd)	2021 (tpd)	2025 (tpd)
Medium & heavy-duty trucks	156.4	76.5	45.7
Farm equipment	48.4	34.0	26.6
Light-duty vehicles	20.7	8.6	6.5
Trains	13.4	12.9	11.6
Construction, mining & logging equipment	10.8	9.9	6.0
Irrigation pumps	10.2	3.7	3.0
Off-road equipment	8.4	5.0	4.0
Glass and related products	6.2	4.5	4.7
Buses	6.0	3.0	2.0
Residential gas and oil combustion	5.9	6.0	5.9
Remaining emission categories	31.7	32.1	33.7
Total	**318.1**	**196.2**	**149.7**

Annual PM2.5 Emissions:
Benefits of Current Control Program

	2013 (tpd)	2021 (tpd)	2025 (tpd)
Tilling, cultivation, harvesting	11.6	11.2	11.0
Fugitive windblown dust	7.5	7.3	7.1
Paved road dust	4.8	5.4	5.8
Medium & Heavy-duty trucks	4.8	1.4	1.2
Residential wood combustion	4.4	3.8	3.8
Unpaved road dust	3.7	3.7	3.7
Commercial cooking	3.6	4.1	4.3
Farm Equipment	2.8	2.0	1.6
Managed farm burning	2.0	1.9	1.9
Fuel use, oil & gas production	1.7	1.4	1.3
Remaining emission categories	16.6	17.4	17.7
Total	**63.5**	**59.6**	**59.4**

Annual SOx Emissions:
Benefits of Current Control Program

	2013 (tpd)	2021 (tpd)	2025 (tpd)
Glass & related products	2.0	2.0	2.1
Industrial fuel combustion	0.8	0.8	0.8
Chemical manufacturing and storage	0.8	0.9	1.0
Fuel use, oil and gas production	0.7	0.3	0.2
Power generation	0.6	0.6	0.6
Food production	0.6	0.5	0.5
Oil and gas	0.5	0.4	0.4
Mineral processes	0.4	0.5	0.5
Medium & heavy duty trucks	0.4	0.4	0.3
Commercial & service fuel combustion	0.4	0.3	0.3
Remaining emission categories	1.3	1.5	1.7
Total	**8.5**	**8.2**	**8.4**

Annual Ammonia Emissions:
Benefits of Current Control Program

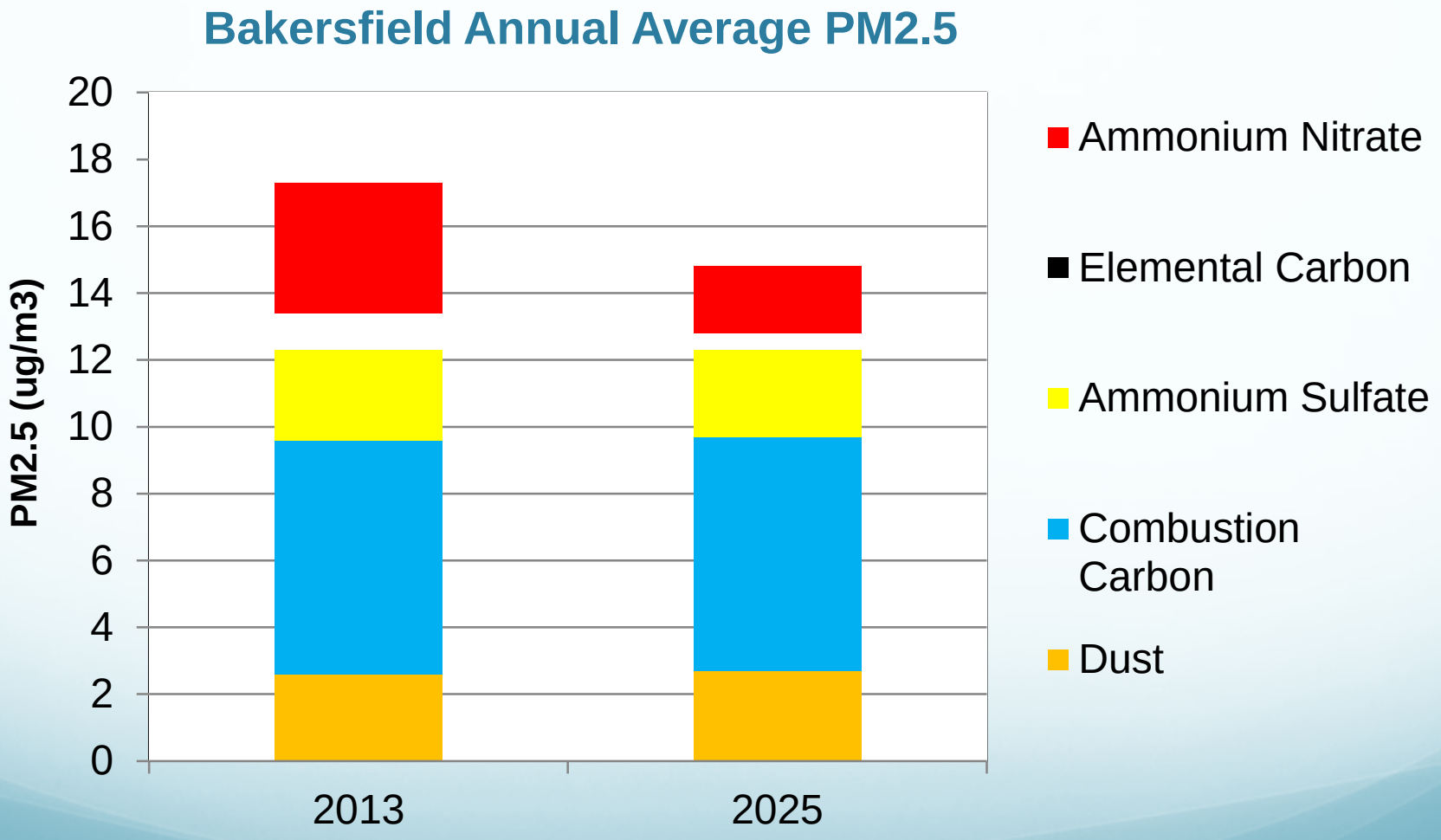
	2013 (tpd)	2021 (tpd)	2025 (tpd)
Dairy cattle	125.3	125.3	125.3
Pesticides and fertilizers	117.6	112.5	109.9
Other livestock	61.2	61.2	61.2
Other waste disposal	8.7	9.9	10.6
Other miscellaneous processes	6.1	6.9	7.3
Light-duty vehicles	2.5	2.2	2.2
Power generation	1.8	1.7	1.8
Medium and heavy-duty trucks	1.6	1.0	0.7
Chemical manufacturing and storage	1.1	1.3	1.4
Landfills	0.7	0.8	0.8
Remaining emission categories	2.3	2.5	2.5
Total	**328.9**	**325.2**	**323.9**

Emissions Inventory Improvements Underway

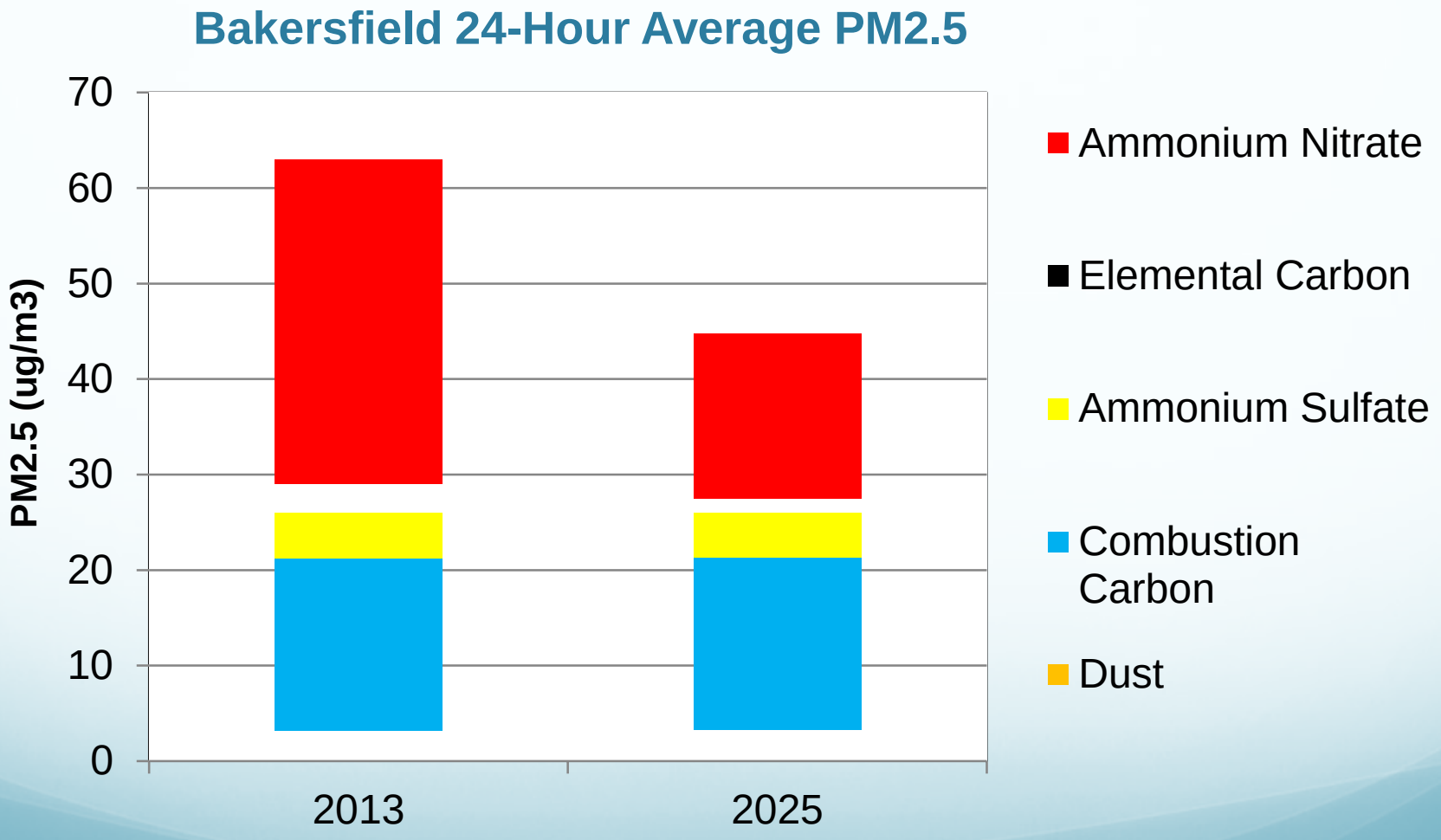
- Updated Locomotive emissions
  - Revised tier and age distribution
- Updated paved and unpaved road dust emissions
  - Incorporates AP-42 dust fraction
- Updated monthly distribution of crop emissions
- Residential burning
  - Reflects updated Valley activity survey
  - Includes woodstove replacements due to Valley incentive programs

What are the Air Quality Benefits of the Current Control Program?

Current Control Program Provides for Significant Progress



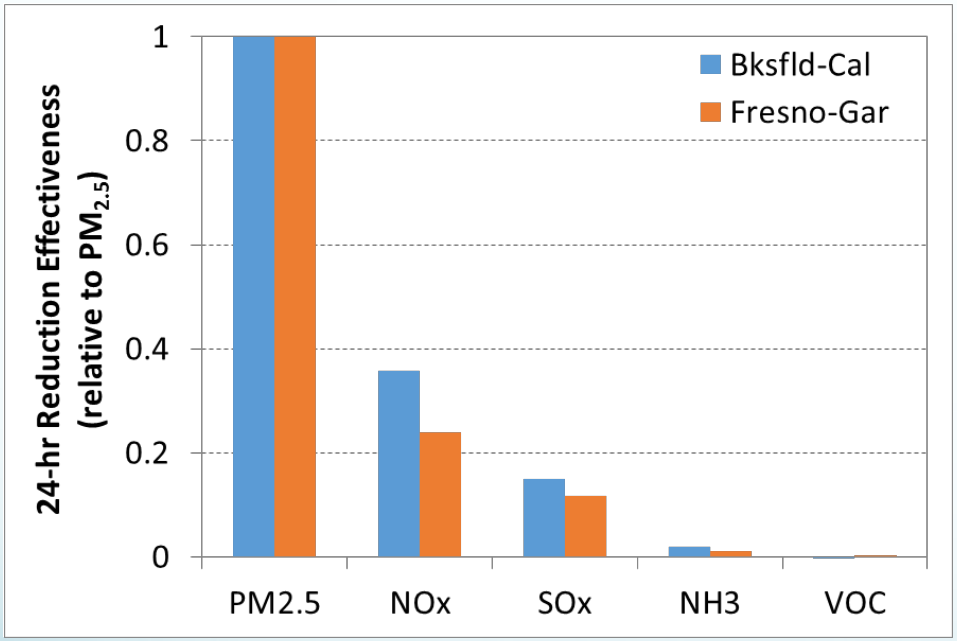
Current Control Program Provides for Significant Progress



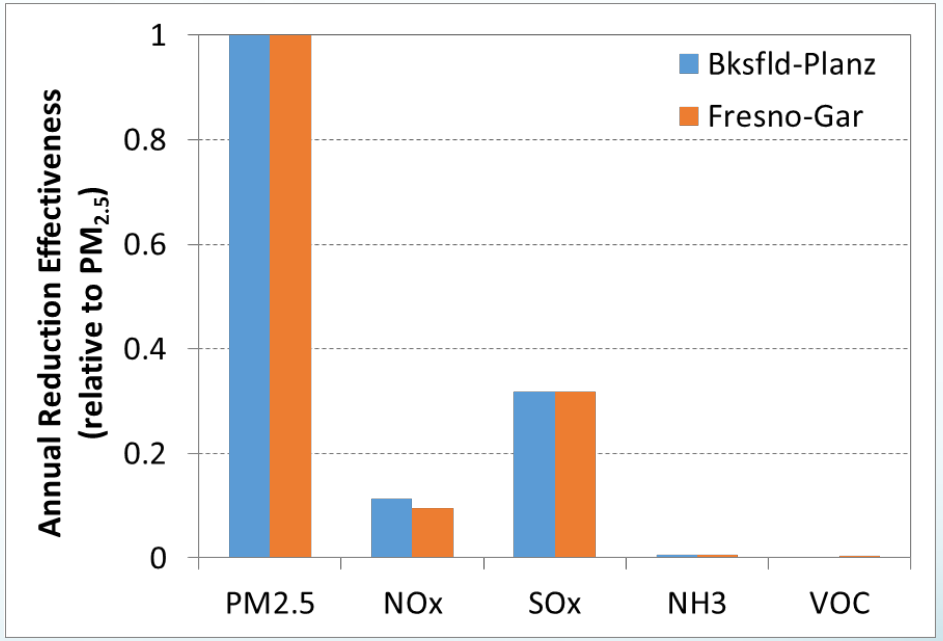
Which Sources Offer the Greatest Opportunities for Reducing PM2.5?

Actions to Reduce Directly Emitted PM2.5 Are Most Effective

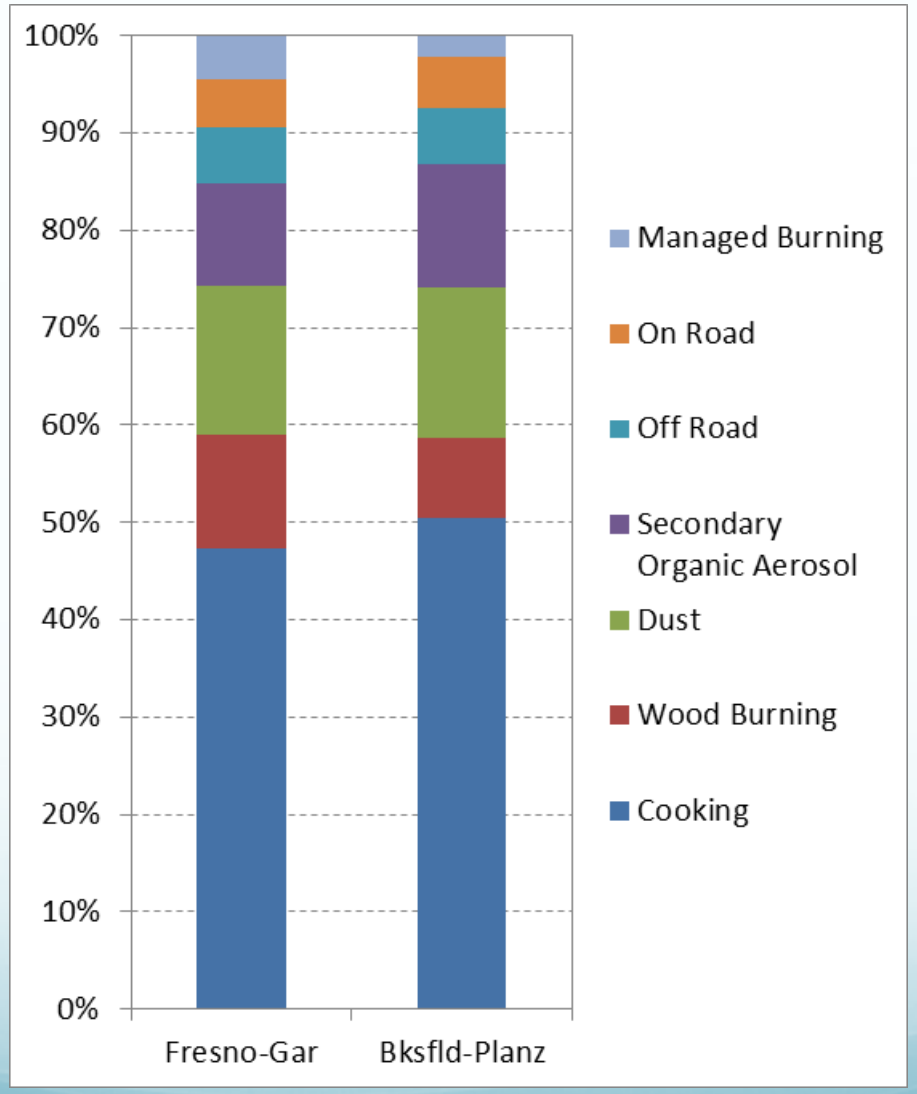
24-Hour Average PM2.5



Annual Average PM2.5



Largest Carbon Contributions in 2025 are from Cooking, Wood Burning, and Dust

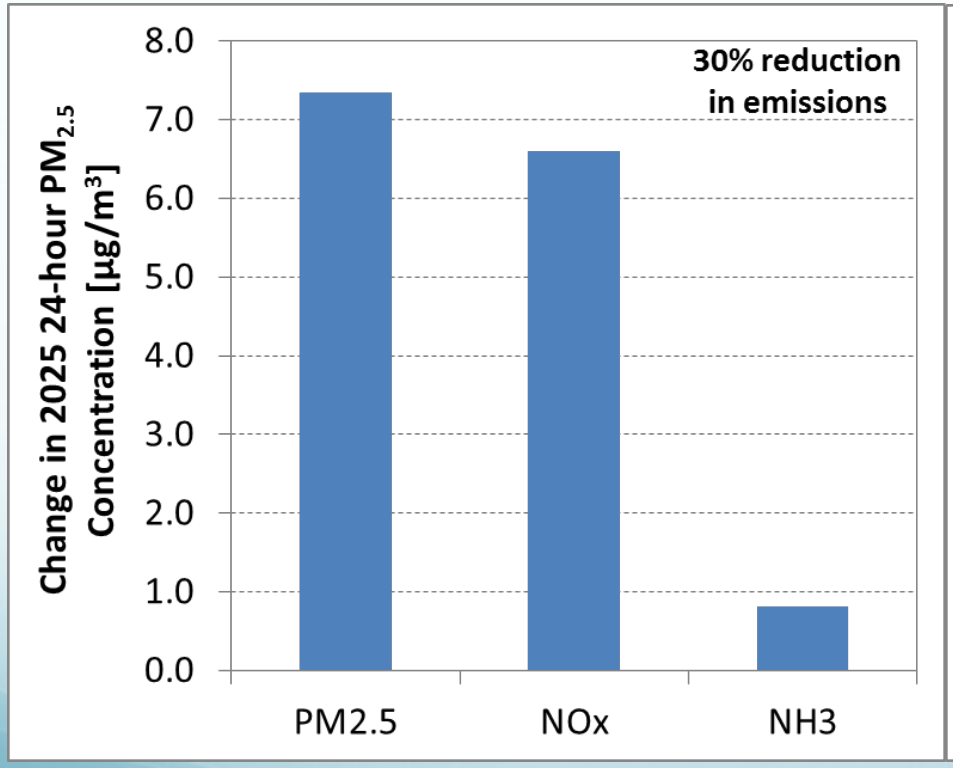


U.S. EPA PM2.5 Precursor Demonstration Guidance

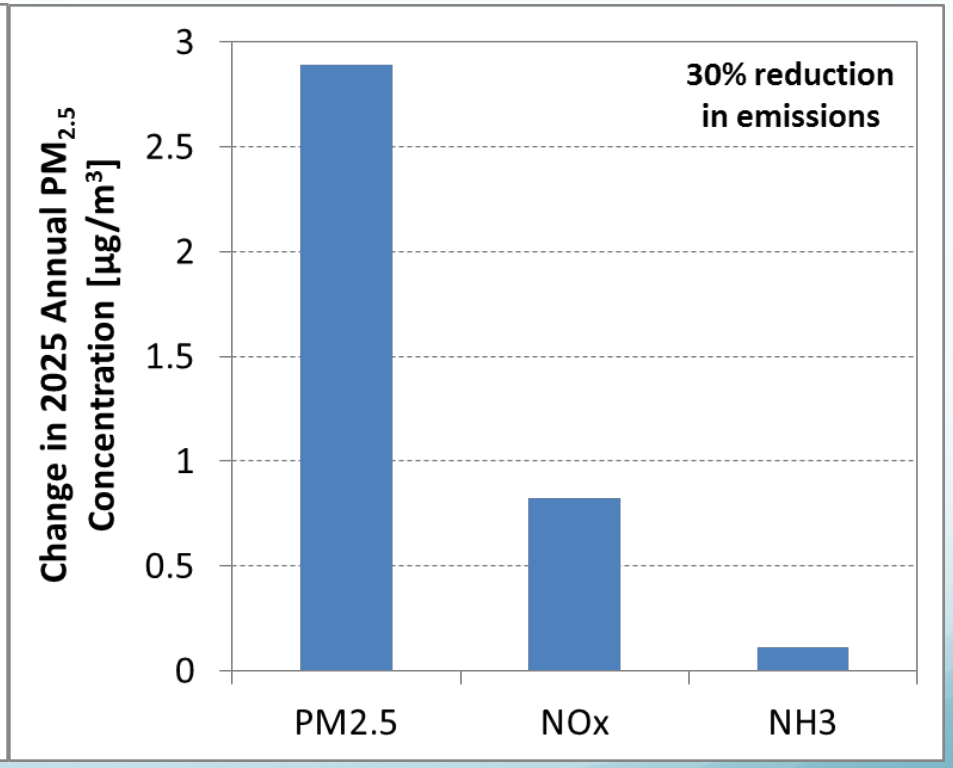
- Specifies modeling approach to demonstrate whether precursor emissions contribute significantly to PM2.5 levels
- Recommends modeling 30-70% reductions in anthropogenic precursor emissions in the nonattainment area
- Recommends thresholds below which air quality change is considered “insignificant”:
  - 0.2 µg/m^3 for annual PM2.5
  - 1.3 µg/m^3 for 24-hour PM2.5

Preliminary Precursor Assessment

24-hour Average PM2.5



Annual Average PM2.5



Key Findings

- Mobile source NOx and diesel PM reductions provide majority of progress by 2025
- Further reductions in NOx and directly emitted PM2.5 needed to meet both annual and 24-hour standards
- Reductions in sources of directly emitted PM2.5 most effective
- PM2.5 is very responsive to controls on cooking, dust sources, and wood burning
- NOx controls significantly more effective than ammonia in reducing ammonium nitrate

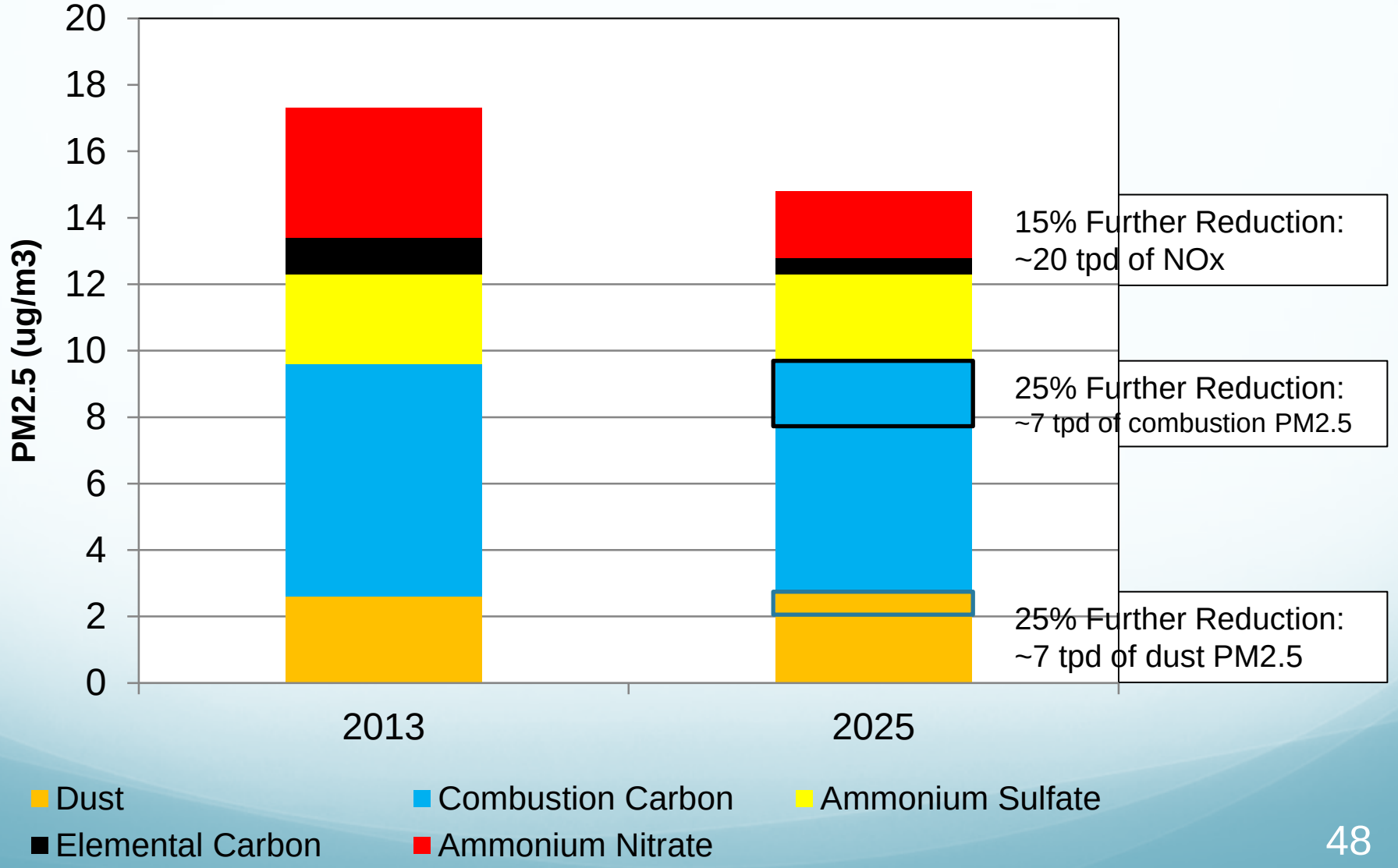
Attainment Strategy Approach

Strategy Design Principles

- Focus on largest remaining constituents
- Consider most effective precursors
- Address increase in fugitive dust resulting from drought
- Consider strategies that provide multiple benefits:
  - Reducing localized exposure
  - Reducing climate pollutants such as black carbon
  - Accelerating ozone progress
- Pursue opportunities for near-term reductions

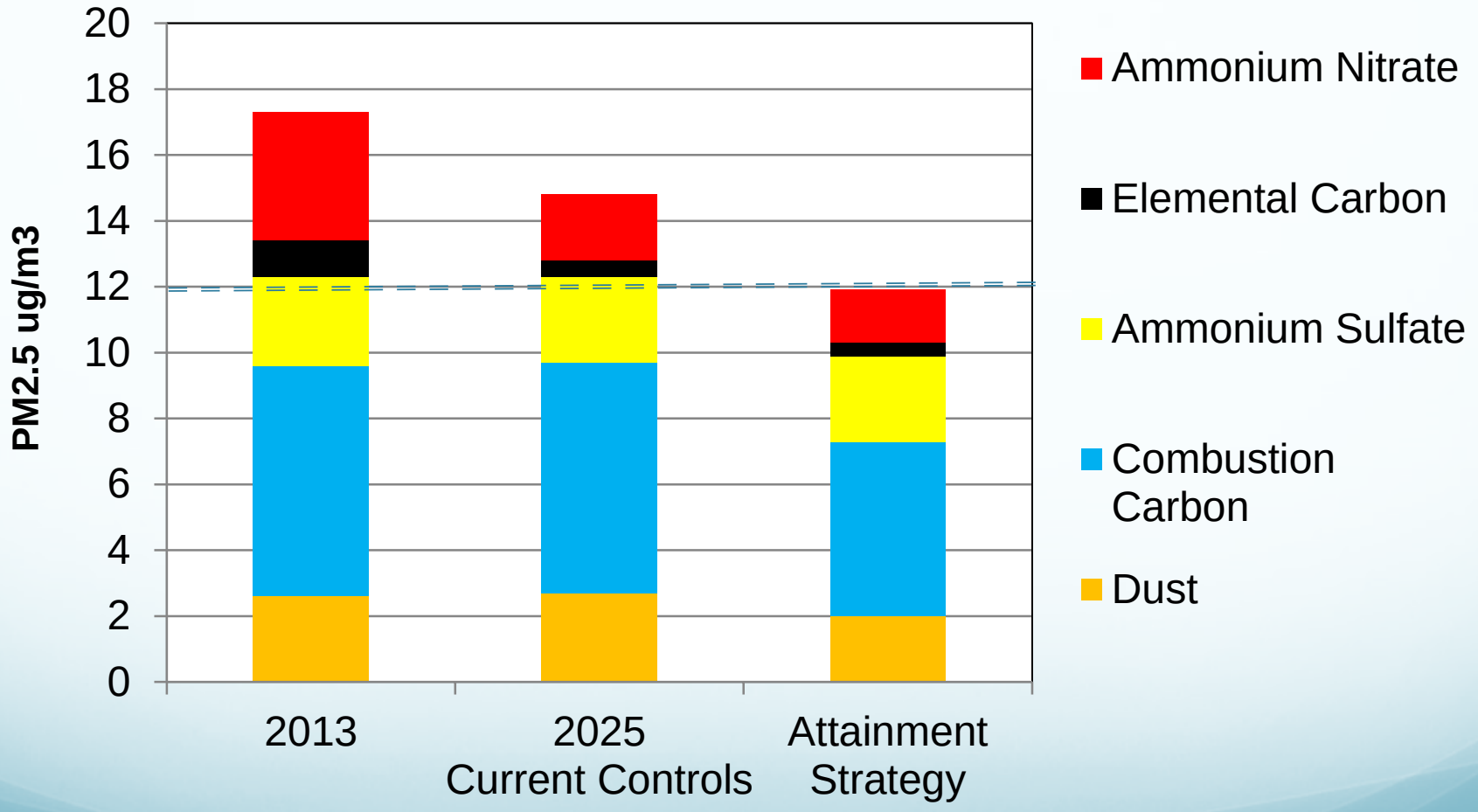
Proposed Strategy Reductions

Bakersfield Annual Average PM2.5



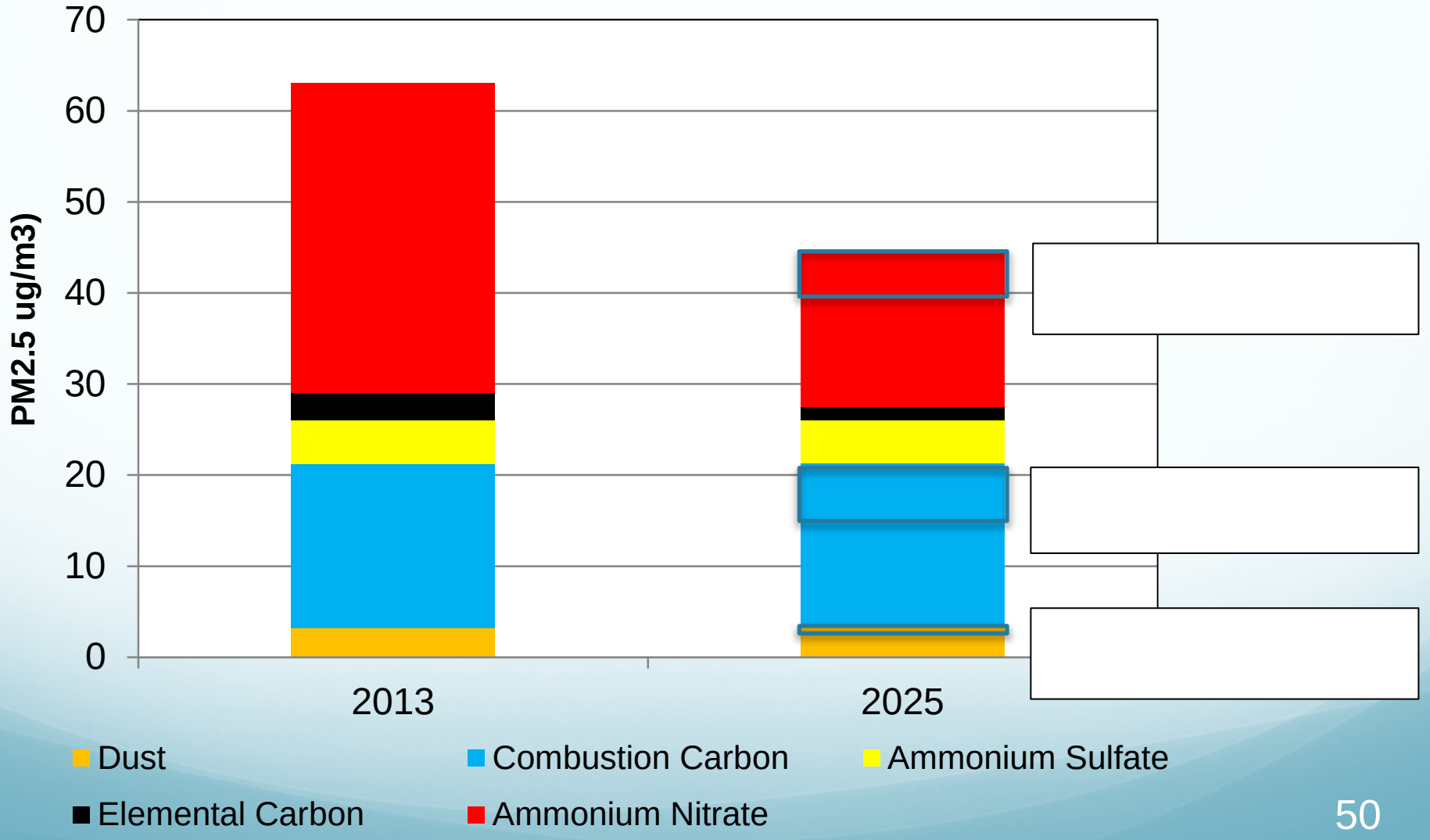
Strategy Provides for Annual Attainment

Bakersfield Annual Average PM2.5



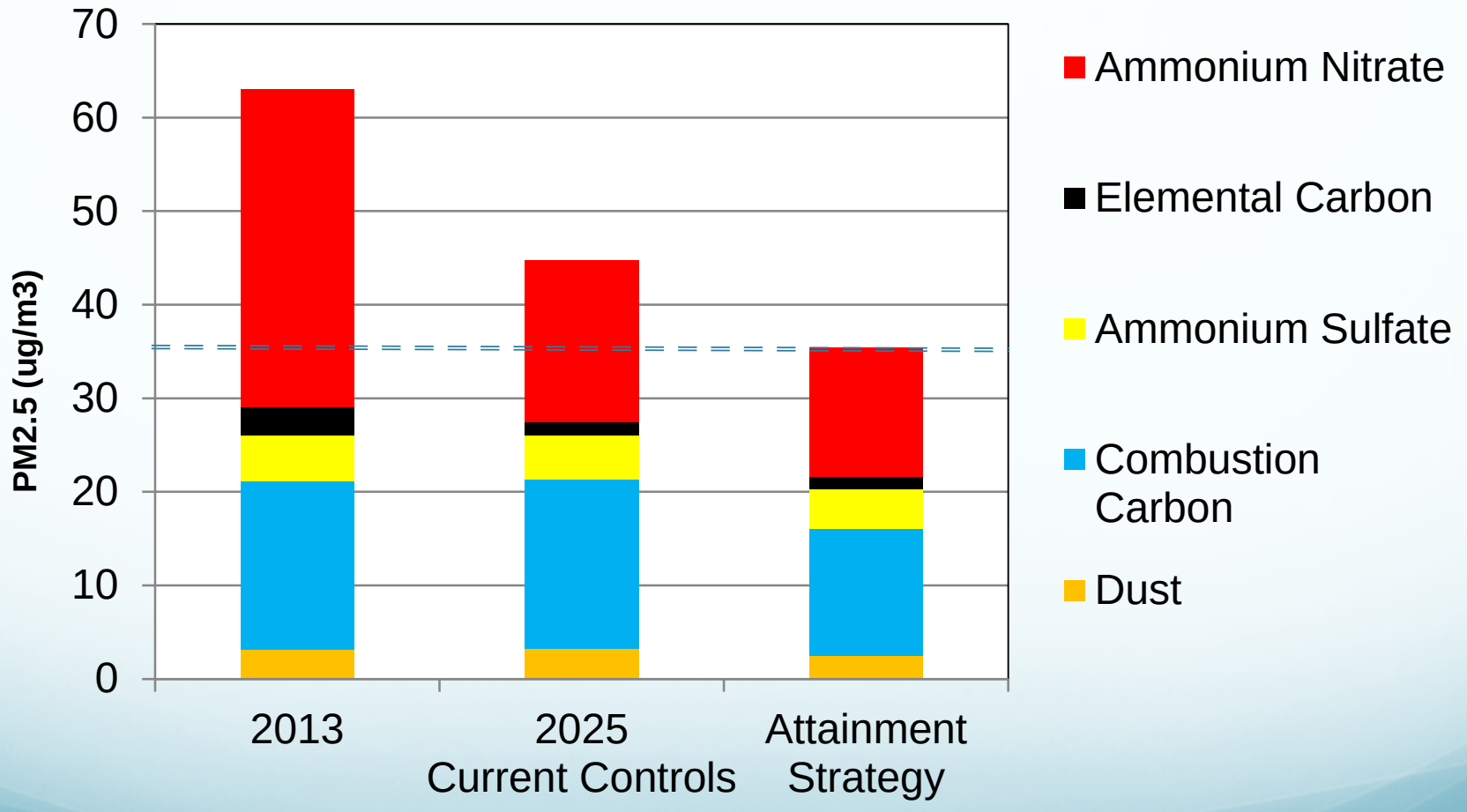
Proposed Strategy Reductions

Bakersfield 24-Hour Average PM2.5



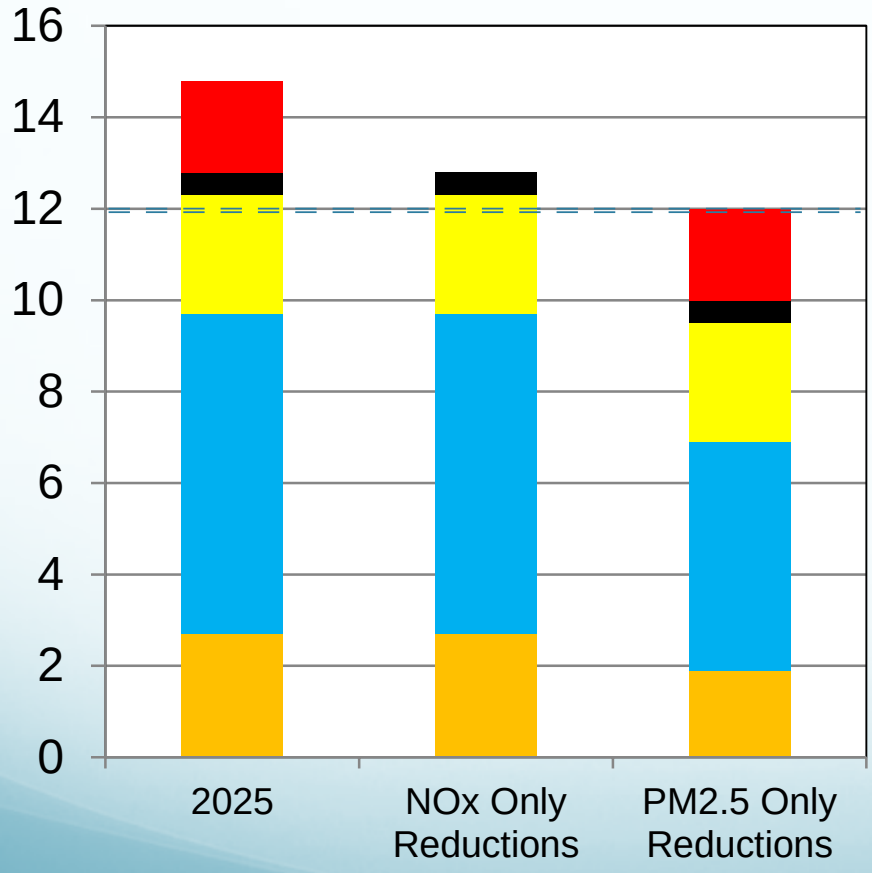
Strategy Provides for 24-Hour Attainment

Bakersfield 24-hour Average PM2.5

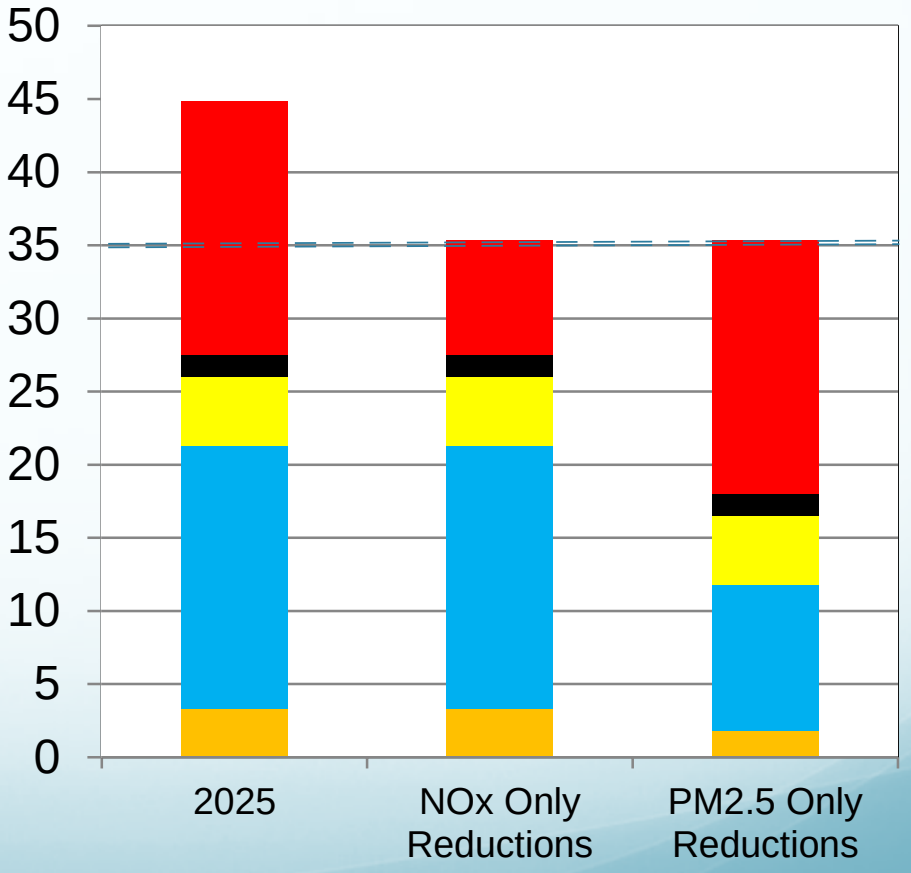


Alternative Approaches Don't Provide for Attainment

Annual Average PM2.5



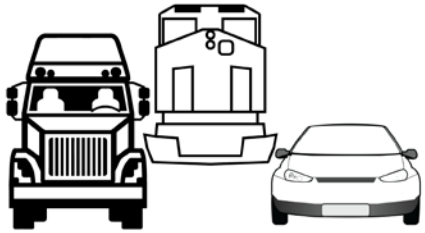
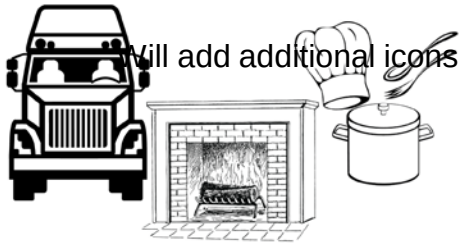
24-Hour Average PM2.5



Science-Based Attainment Strategy

- Balanced approach focusing on both directly emitted PM2.5 and NOx reductions
- Achieves annual and 24-hour standards
- Directly emitted PM2.5 measures:
  - Most effective in reducing PM2.5 levels
  - Reduce localized exposure
  - Provide opportunities for near-term reductions
  - Reduce black carbon
- NOx measures:
  - Accelerate ozone progress
  - Targeted incentives provide opportunities for near-term reductions
  - Zero emission technologies support climate goals

Attainment Strategy Reductions
(between 2013 and 2025)

NO_x Emissions	Carbon Emissions	Dust Emissions
	 Will add additional icons	
62%	37%	20%

Opportunities for Emission Reductions

Potential approaches based on public and agency comments

Mobile Source Strategy

- Future reductions from current mobile source control program: 168 tpd of NOx
- Goal for reductions from new strategies: ~30 tpd
- Proposed State SIP Strategy provides 5 tpd new reductions by 2024/2025
  - Low NOx standard for heavy-duty trucks
  - Last Mile Delivery
  - Advanced Clean Transit
  - Tier 5 engine standard for locomotives
  - Low emission diesel fuel standard
- Continuation of existing incentive programs would provide 10 tpd by 2024/2025
  - Ag tractors: 7.5 tpd
  - Moyer: 2.5 tpd
- Need incentives to accelerate remaining State SIP strategy reductions from 2031 to 2024/2025 to achieve final 15 tpd reductions
  - Low-NOx trucks
  - ZEV/PHEV passenger vehicles
  - Tier 4/5 locomotives

Other Opportunities for NOx Reductions

- Public fleet rules to require cleanest technologies for new vehicle purchase
- Updates to Indirect Source Rule
- More stringent engine standards for agricultural IC engines
- More stringent limits for glass melting furnaces
- Requirements for flaring best practices and use of ultra-low NOx flare technologies
- Agricultural tractor rule

Overcoming Barriers: NOx

- Call for U.S. EPA action on low-NOx standard for heavy-duty trucks and tier 5 standards for locomotives
- Identification of funding to accelerate deployment of new technologies in coordination with the South Coast
- Continued work with U.S. EPA on demonstration of SIP creditability of incentive-based reductions

Opportunities for Combustion Carbon Reductions

- Future reductions from current control program: 5 tpd
- Goal for reductions from new strategies: ~7 tpd
  - Continued Incentives for replacement of fireplaces and woodstoves
  - More stringent limits for wood burning curtailment
  - Further limitations on wood burning devices in new homes
  - Expand charbroiling rule to include underfired broilers
  - Pursue alternatives to agricultural burning
  - Benefits from mobile source NOx measures

Overcoming Barriers: Carbon

- Reducing costs of charbroiling control technologies
- Identification of continued funding for woodstove and fireplace replacements
- Education and outreach on availability of alternatives to residential wood burning
- Development of beneficial uses of ag waste
  - Ag Waste Biomass Summit planned for spring 2017

Opportunities for Dust Reductions

- Future reductions from current control program: 0 tpd
- Goal for reductions from new strategies: ~7 tpd
  - Update Conservation Management Practices
  - Update Regulation VIII to reduce fugitive dust from open areas and roads
  - Updates to Indirect Source Rule

Overcoming Barriers: Dust

- Continued assessment of fugitive dust sources which have greatest impact
- Drought limits availability of water as dust suppression mechanism
- Economics of agricultural operations

Other Opportunities for Reductions

- Potential SOx co-benefits from other strategies
- Potential ammonia strategies

Next Steps

- December 7: District workshop
- January-February: Additional ARB workshops
  - Focused discussion on potential measures and barriers
  - Recommended actions on specific measures
- February: Report back to ARB Board
- January – Summer: District SIP development process
- August: District Board consideration of integrated SIP
- September: ARB Board consideration of integrated SIP

Questions?