SAN JOAQUIN VALLEY 2012 PM2.5 SIP

Overview of PM2.5 Science & Research

California Air Resources Board
January 24, 2013

Outline

- Current scientific knowledge of 24-hour PM2.5 pollution in the San Joaquin Valley
- Use of photochemical models to determine precursor limitations
- Ongoing efforts to improve the scientific foundation

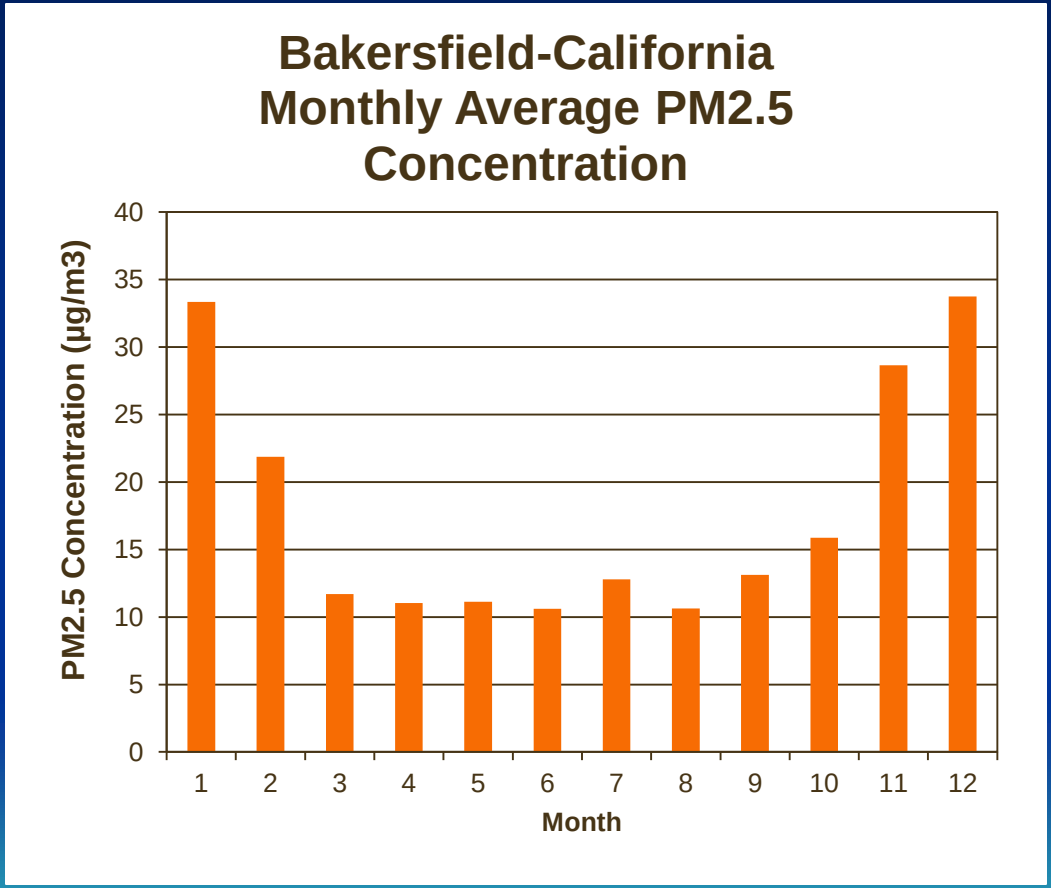
Science in the SIP Process

- Requires a strong scientific foundation
- Provides ambient measurements to expand our understanding of the nature of PM2.5
- Improves the algorithms in models and their ability to simulate air quality conditions
- Supports model applications to predict future air quality and the response to controls

California Regional Particulate Matter Air Quality Study (CRPAQS)

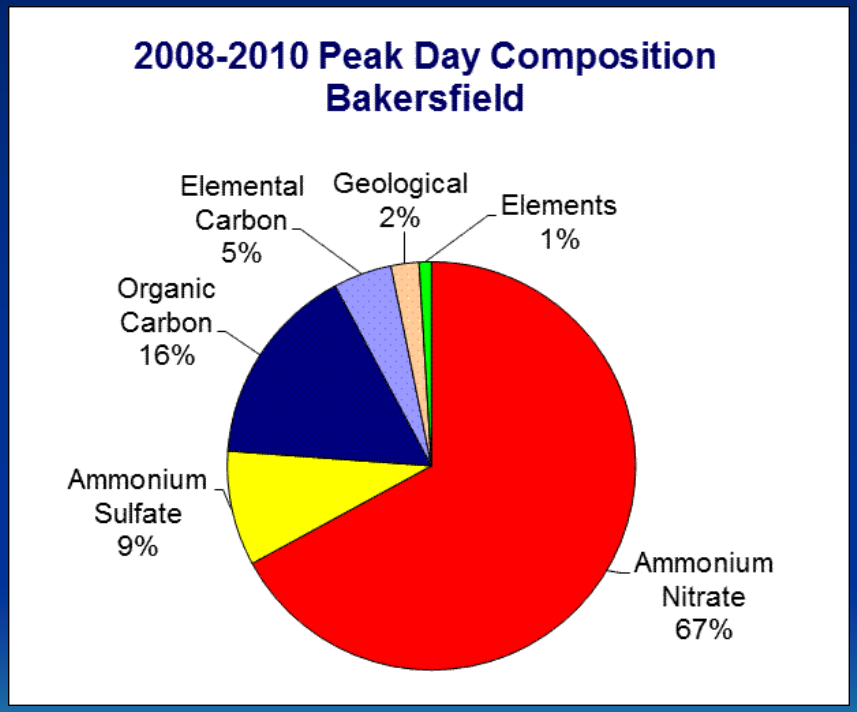
- Major field study conducted in 2000
- Funded by a public/private partnership
- Provided the fundamental science behind annual plan and current 24-hour plan
- Most comprehensive data and science in the country on the origin and fate of PM2.5
- Continues to be a cornerstone of PM2.5 research

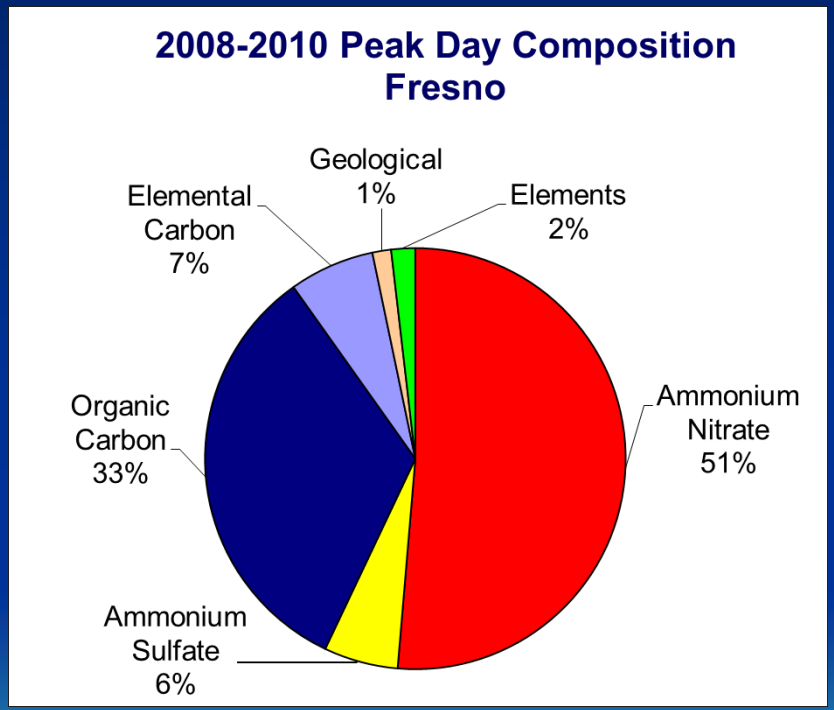
High PM2.5 Levels Occur In Winter



- PM2.5 builds up over several days or weeks (episode)
- Episodes generally occur during periods with:
  - stagnation
  - cool temperatures
  - high humidity
  - low mixing depths

PM2.5 Chemical Composition





Ammonium Nitrate

- Further oxidation of oxides of nitrogen (NOx) leads to the formation of nitric acid
- Nitric acid reacts with ammonia to form ammonium nitrate which is regional in nature
- Reducing NOx is most effective in reducing ammonium nitrate
- Since 2002, winter-average NOx and ammonium nitrate have decreased by ~40%

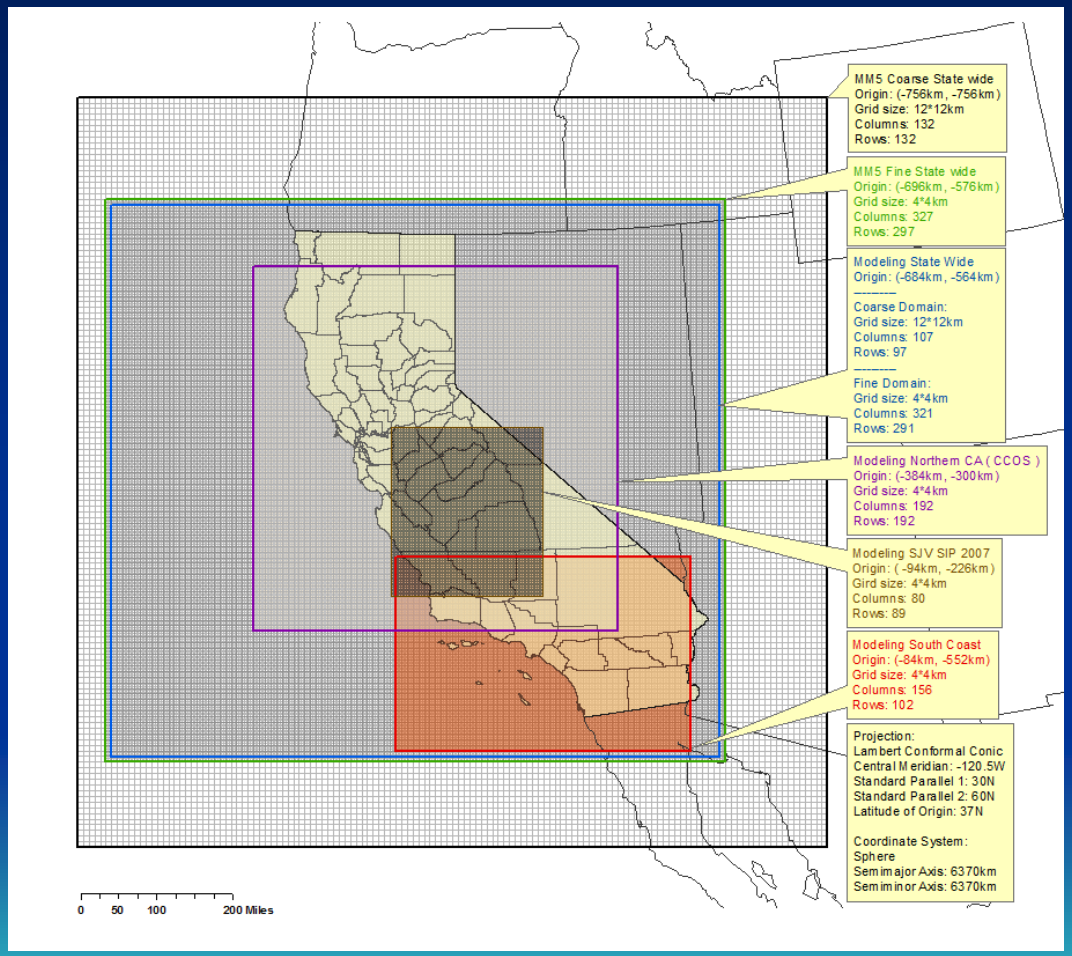
Organic Carbon

- Organic carbon can be either:
  - primary (directly emitted)
  - secondary (formed in the atmosphere)
- Primary organic carbon dominant in winter
- Concentrations are highest in urban areas (wood burning, cooking, and mobile sources)
- Since 2002, winter-average organic carbon has decreased ~50%

Use of Photochemical Models

- Identifying the most effective mix of pollutants to control
- Establishing attainment targets
- Models are best used in a relative (rather than absolute) sense
- Attainment test combines measured data and modeling to project air quality into the future

Modeling Process



Meteorology Model: Predicts weather variables for every grid cell every few seconds for an entire year

Air Quality Model: Predicts all components of PM2.5 for every grid cell every few seconds for a year

Model Performance Evaluation: Does the model replicate the observed nature of the PM2.5 problem?

Determining Precursor Sensitivity

- Air quality models provide the best tool to evaluate the potential effectiveness of controlling different PM2.5 precursors
- We have conducted model sensitivity runs for NOX, Primary PM2.5, NH_3, VOC, and SOX
- This analysis has been done as part of previous modeling efforts for CRPAQS as well as the current PM2.5 plan
- The current plan integrates results of these studies in determining the most effective control approach

Effect of 25% Precursor Reductions at Bakersfield – California

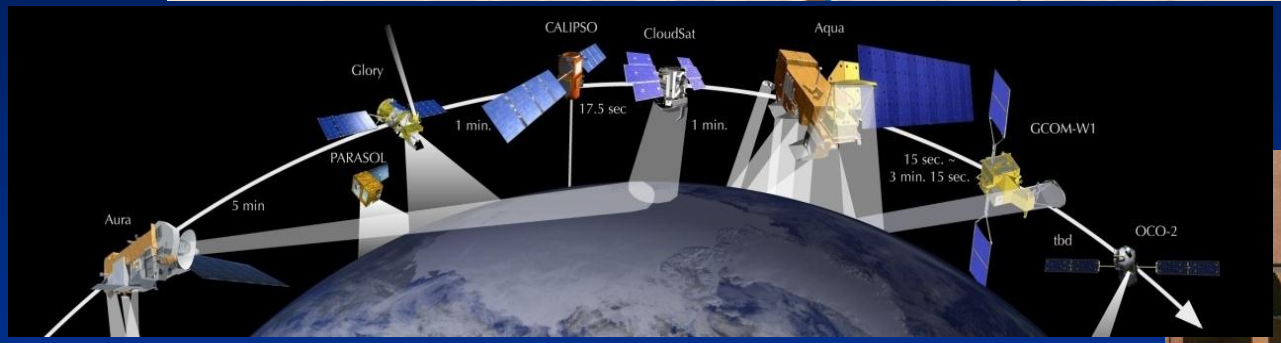
Precursor	$PM_{2.5}$ Reduction ($\mu g/m^3$)	$\mu g/m^3$ Reduction/ton
Primary PM2.5	4.44	0.34
NOx	3.75	0.08
NH_3	0.55	0.008
SOx	0.18	0.08
VOC	-0.10	-0.001

Summary of Precursor Effectiveness

- Reductions in direct PM2.5 are the most beneficial
- NOx controls also provide large benefits
- NH_3 controls offer very small benefits
- VOC controls produce very small disbenefits

Ongoing Efforts to Improve Science

- Annual science meetings:
  - *International Conference on Atmospheric Chemical Mechanisms*
  - *International Aerosol Modeling Algorithms Conference*
  - *International Conference on Meteorology Modeling*
- Field studies to improve modeling databases:
  - *U.S. EPA/ARB Advanced Monitoring Initiative (Feb. 2007)*
  - *ARCTAS (June 2008)*
  - *CalNex (May-July 2010)*
  - *Discover AQ (Jan-Feb 2013)*



- A five-year NASA campaign to improve the use of satellites to monitor air quality
- Deployment began on January 16, 2013 in the San Joaquin Valley
- ARB and EPA, together with academia, are major collaborators

San Joaquin Valley 2012 PM2.5 SIP

Outline

- Proposed Board Action
- Nature of Valley's PM2.5 Problem
- Attaining the PM2.5 Standard
- Future Valley SIPs

Proposed Board Action

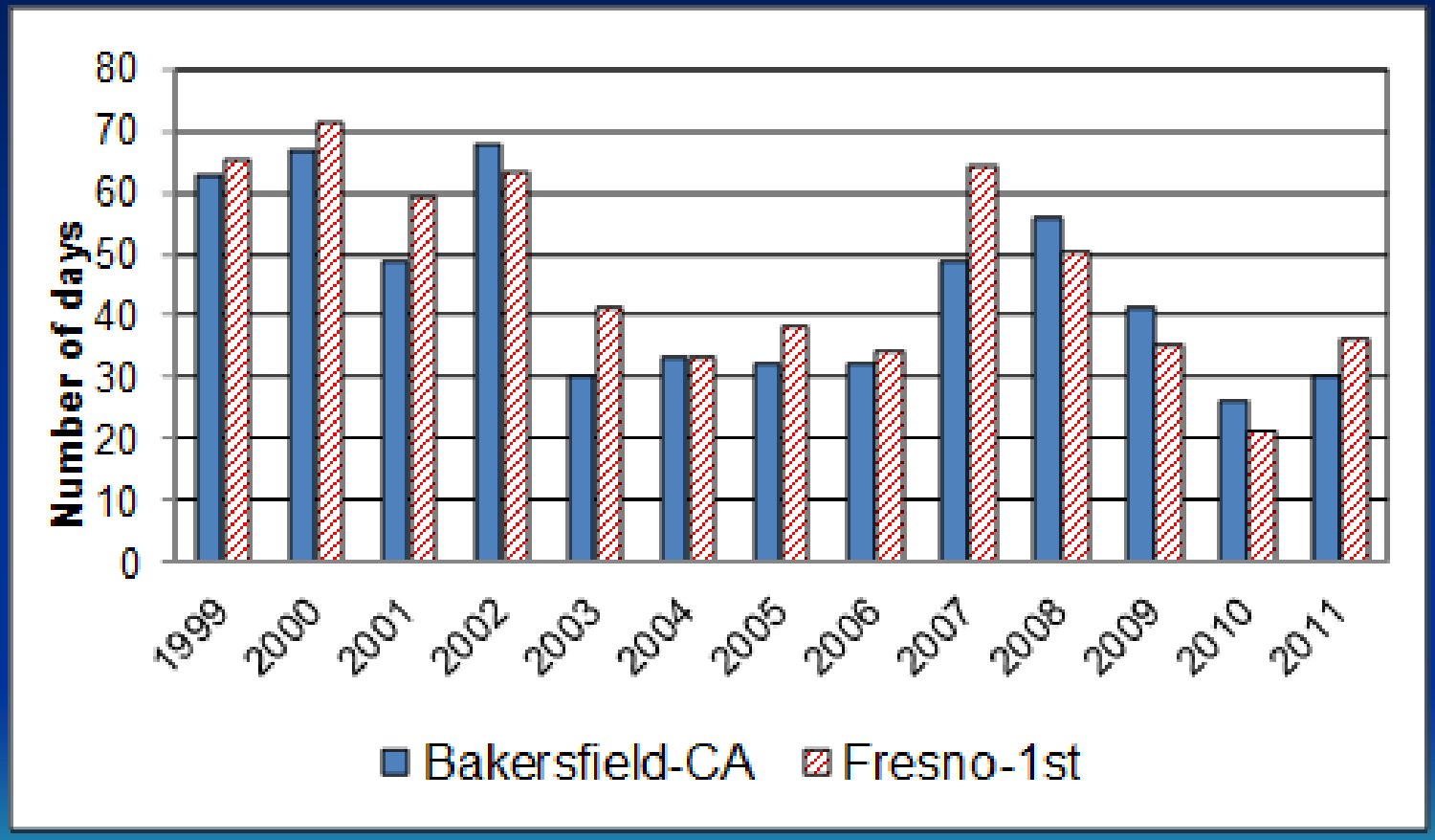
- District adopted 2012 PM2.5 SIP on December 20, 2012
- SIP meets Clean Air Act requirements
- Staff recommending approval

Nature of the Valley's PM2.5 Problem

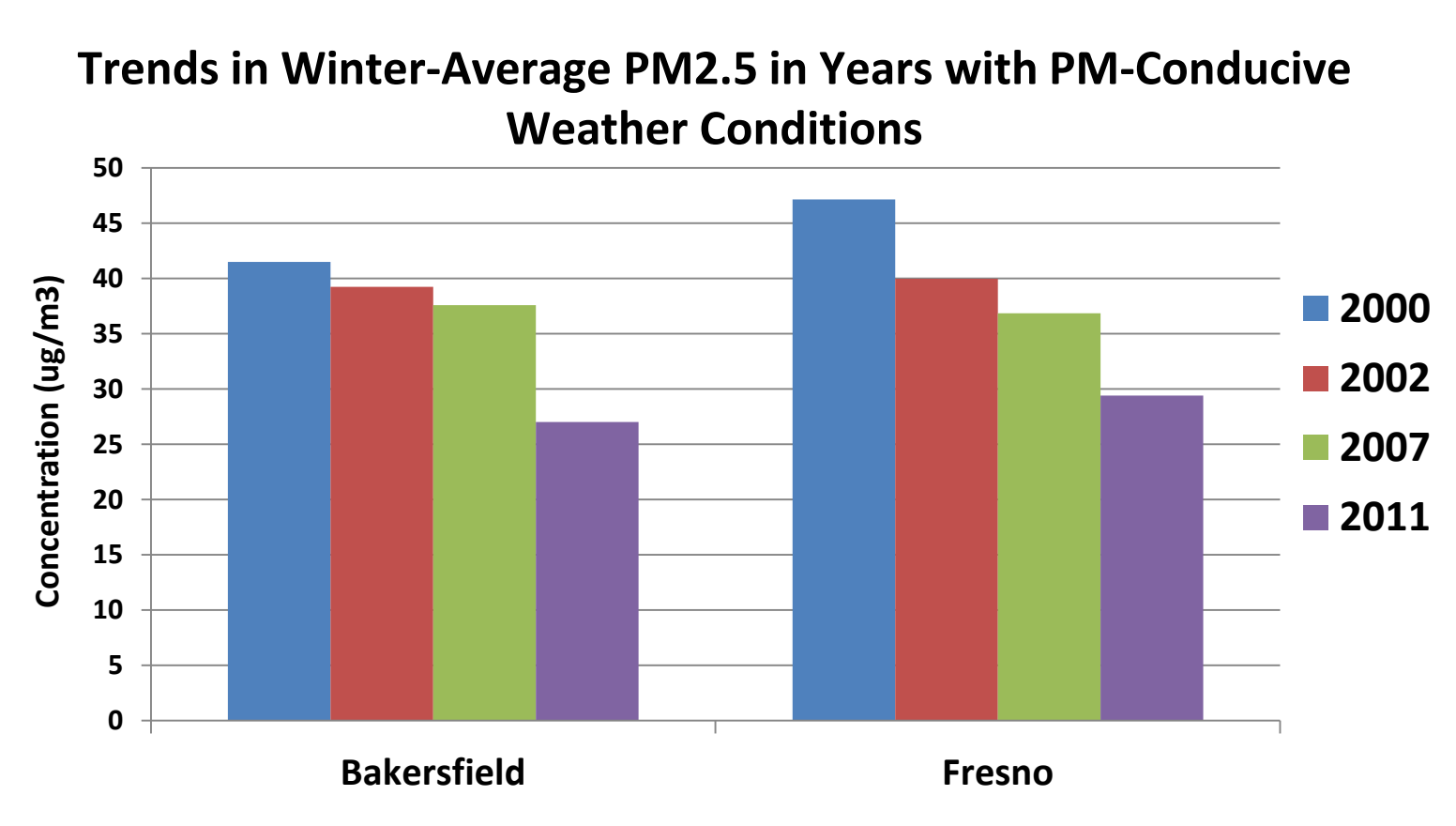
Valley Conducive to Pollutant Formation

- PM2.5 builds up over several days or weeks (episode)
- Episodes generally occur during winter periods with:
  - Stagnation
  - Cool temperatures
  - High humidity
  - Low mixing depths

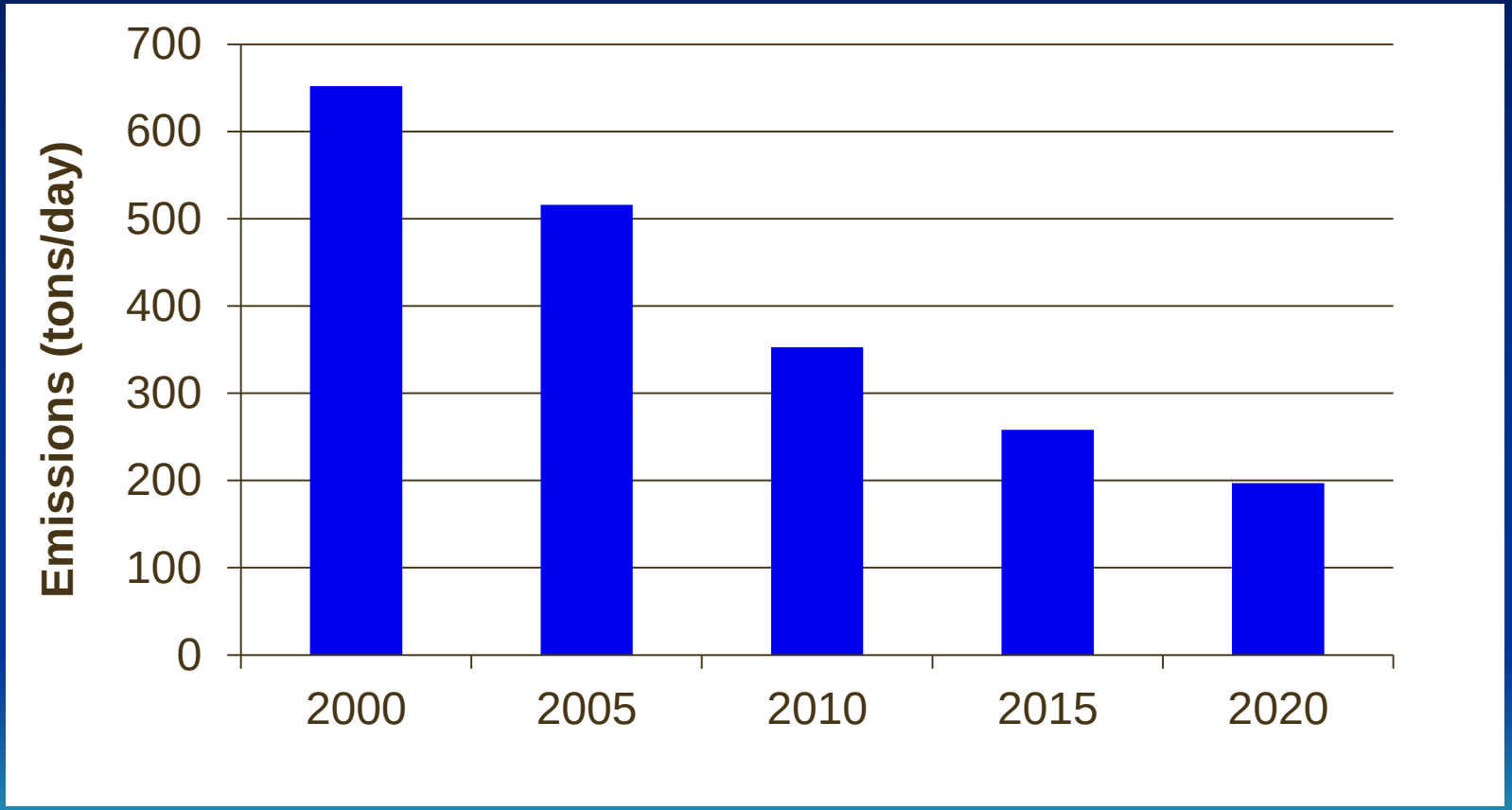
Year to Year Variability



Progress Accounting for Weather



Ongoing NOx Reductions



Preliminary Assessment of 2012 PM2.5 Data

- 2011 weather was very conducive to high PM2.5 concentrations
- 2012 weather was more moderate
- Most 2012 PM2.5 design values expected to improve compared to 2011

Attaining the PM2.5 Standard

Current PM2.5 SIP Revision

- District adopted SIP revision on December 20, 2012
- Addresses 35 ug/m3 PM2.5 standard established in 2006
- 90% of Valley attains by 2017; remaining Bakersfield site attains by 2019

Attainment Demonstration

- Ongoing ARB and District programs and enhanced wood burning rule bring Valley into attainment with exception of Bakersfield
- Commercial cooking measure brings Bakersfield into attainment

Importance of Controlling Directly Emitted PM2.5

- Ammonium nitrate is decreasing Valleywide
- Directly emitted PM2.5 significant contributor to wintertime PM2.5 episodes
- Key attainment strategy:
  - Diesel engines and passenger vehicles
  - Residential wood burning
  - Commercial cooking operations

Curtailing Residential Wood Burning

- Exposure to wood smoke increases hospitalization and emergency room visits for:
  - Asthma
  - Other respiratory illnesses
  - Cardiovascular disease
- District's current rule provides significant health benefits
- Strengthening rule provides additional protection for children, asthmatics, and other sensitive populations

Reducing Commercial Cooking Emissions

- Current District rule applicable to chain driven devices
- Expands rule to under-fired devices
- Pushes technology advancement
- District working with South Coast

“Significant” PM2.5 Precursors

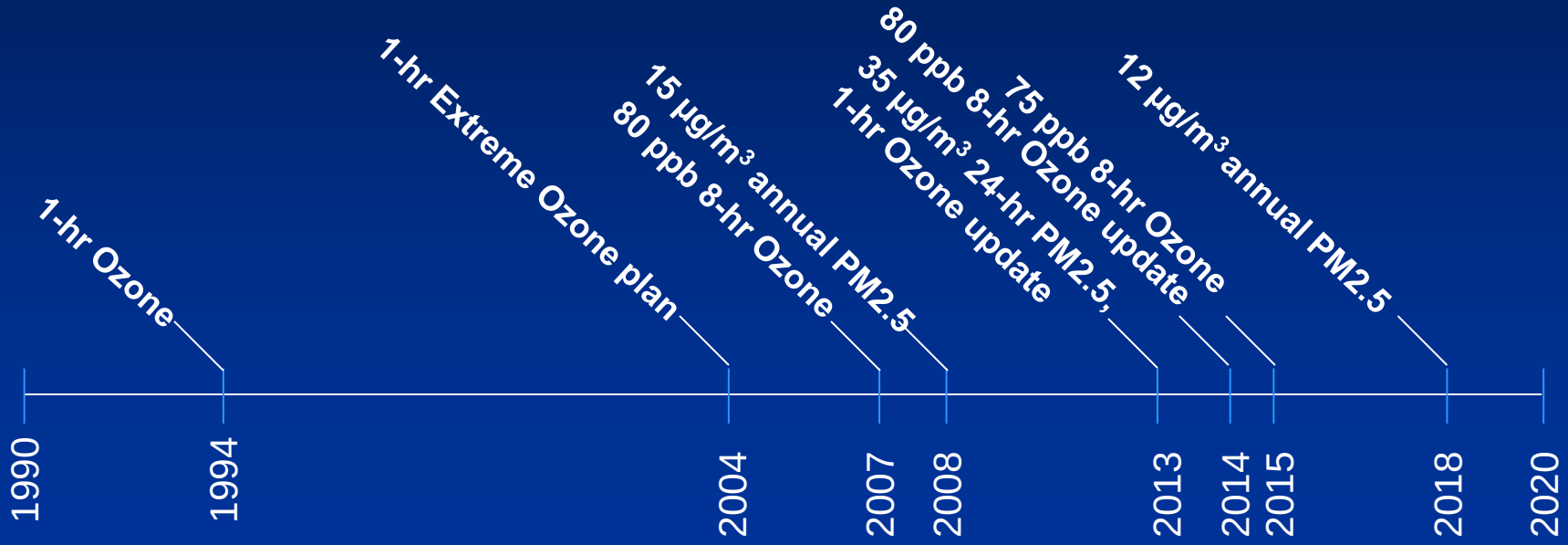
- Under EPA Rule, PM2.5, NOx, and SOx are presumptive “significant” precursors
- Latest science shows PM2.5, NOx and SOx are “significant” precursors for the 24-hour SIP
- Approved annual SIP determined these same precursors were “significant”

Other Clean Air Act Requirements

- ✓ Emission Inventory
- ✓ Reasonable Further Progress
- ✓ Reasonably Available Control Measures
- ✓ Contingency

Future Valley SIPs

San Joaquin Valley SIP Timeline



Multi-Pollutant Planning

- Integrate ARB planning efforts for SIPs, AB 32 Scoping Plan, and freight planning
- Multiple SIPs for ozone and PM2.5, but common strategies
- Periodic standard review by EPA required by the Clean Air Act

Recommendation

- Approve San Joaquin Valley 2012 PM2.5 Plan as a revision to the California State Implementation Plan