

**SACRAMENTO METROPOLITAN AIR QUALITY
MANAGEMENT DISTRICT**

For Agenda of: March 24, 2005

To: Board of Directors
Sacramento Metropolitan Air Quality Management District

From: Larry Greene
Air Pollution Control Officer

Subject: Information on Particulate Matter and Implementation of Senate Bill
656, Sher 2003

Recommendation: Information item to begin discussions of potential strategies
to reduce particulate matter pollution as required by SB656.

Exposure to particulate pollution is linked to increased frequency and severity of asthma attacks, pneumonia and bronchitis, and even premature death in people with pre-existing cardiac or respiratory disease. Those most sensitive to particle pollution include infants and children, the elderly, and persons with heart and lung disease. These particles can pass through the nose and throat to reach deep into the lungs. Emerging research suggests the smallest particles may penetrate the lung walls. Some particles, such as diesel smoke, are toxic.

Particulate matter pollution is not one pollutant. It consists of a mixture of very small liquid and solid particles suspended in the air. Health concerns are linked to particles smaller than 10 microns in size (PM10), and the subset of fine particles smaller than 2.5 microns in size (PM2.5). Particles with a size between 2.5 and 10 microns are often referred to as coarse particles. State and federal ambient air quality standards have been set for PM10 and PM2.5. Sacramento County exceeds the state standards for both PM10 and PM2.5, but has attained the less protective federal standards.

In 2003, the Legislature enacted Senate Bill 656 (SB 656, Sher), codified as Health and Safety Code (H&SC) section 39614, to reduce public exposure to PM10 and PM2.5 and make progress toward attainment of state and federal; PM10 and PM2.5 standards. SB 656 requires the California Air Resources Board (CARB), in consultation with local air districts, to adopt a list of the most readily available, feasible, and cost-effective control measures that could be employed by CARB and the air districts to reduce PM10 and PM2.5 (collectively referred to as PM). CARB adopted that list in November 2004.

By July 31, 2005, SB656 requires CARB and air districts to adopt implementation schedules for appropriate CARB and air district measures. Finally, no later than January 1, 2009, CARB must prepare a report describing actions taken to fulfill the requirements of the legislation as well as recommendations for further actions to assist in achieving the State PM standards. SB656 requirements sunset on January 1, 2011, unless extended.

Staff's evaluation shows that the largest sources of PM are combustion sources including motor vehicles, wood burning, and cooking. Although fugitive dust sources contribute a substantial amount of PM10, ambient monitoring suggests that the contribution is smaller. Staff is assessing the costs and benefits of measures on CARB's approved list of measures. Staff will return to the Board of Directors, after seeking public input, with a proposed schedule for implementing the control options. The schedule for those actions is:

- Mid-April 2005 – Complete technical assessment
- May 2005 – Public Workshop on proposed list of measures and implementation schedule
- July 2005 – Board Hearing for adoption of the implementation schedules

Respectfully Submitted,

Larry Greene
Air Pollution Control Officer

Attachment: Preliminary Staff Report and List of Measures

**Staff Report
SB656
Assessment and Control Measure Evaluation**

PRELIMINARY DRAFT

March 24, 2005

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Executive Summary

Exposure to particulate pollution is linked to increased frequency and severity of asthma attacks, pneumonia and bronchitis, and even premature death in people with pre-existing cardiac or respiratory disease. Those most sensitive to particle pollution include infants and children, the elderly, and persons with heart and lung disease. These particles can pass through the nose and throat to reach deep into the lungs. Research suggests the smallest particles may penetrate the lung walls. Some particles, such as diesel smoke, are toxic.

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Staff is assessing the costs and benefits of measures on CARB's approved list of measures. Staff will seek Board of Directors approval, after seeking public input, of a proposed schedule for implementing the control options. The schedule for those actions is:

- Mid-April 2005 – Complete technical assessment

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-

Health Effects of Particulate Matter

Particles in the air (particulate matter) are a mixture of solids and liquid droplets that vary in size. Particles less than ten micrometers in diameter pose the greatest health concern because they can pass through the nose and throat and get deep into the lungs. Particles larger than ten micrometers do not usually reach the lungs, but can irritate your eyes, nose and throat.

Short-term exposures to fine and coarse PM lasting 24 hours or less can cause a variety of serious health problems. People with heart or lung diseases and older adults are more at risk of hospital or emergency room visits, and in some cases even death. Long-term exposures of a year or more have been linked to the development of lung diseases, such as chronic bronchitis and asthma, and heart diseases, such as congestive heart failure, coronary artery disease, cardiac arrhythmias and heart attacks. (USEPA AIRNow, 12/15/2004) Long-term exposure to combustion-related PM_{2.5} has also been identified as an environmental risk factor for cardiopulmonary and lung cancer mortality (JAMA, Journal of the American Medical Association, 3/6/2002).

Coarse PM is mostly deposited in the upper respiratory track while ultra fine and fine PM are deposited throughout the respiratory track. An American Cancer Society study (Pope et al., 1995, 2002) that followed more than a half million adults from 151 cities for 16 years found there was an increased risk of lung cancer and an average 1.5 year loss in life expectancy (10 years per premature death) between the least and most polluted cities.

Some components of PM_{2.5} are toxic. Compounds found in the vapor phase of diesel exhaust include benzene, formaldehyde, 1-3-butadiene and ethylene dibromide. At least 16 hydrocarbons that are classified as possibly carcinogenic are adsorbed on diesel exhaust particles (Health Risk Assessment for Diesel Exhaust, CalEPA, May, 1998). Residential wood smoke contains over 100 different chemicals, including dioxins, formaldehyde, benzene, toluene, oxygenated polycyclic aromatic hydrocarbons (PAHs), sulfur dioxide, lead, cadmium, arsenic and methyl chloride (Burning Issues/Clean Air Revival, Inc., June 6, 2001).

The USEPA estimates that wood smoke is 12 times more carcinogenic than equal amounts of tobacco smoke and attacks body cells up to 40 times longer than tobacco smoke (Burning Issues, 2001). A single fire place operating for an

hour and burning 10 pounds of wood generates 4,300 times more carcinogenic PAHs than 30 cigarettes.

Diesel PM emissions are less than five percent of all District PM emissions. Statewide, diesel PM contribute about 70 percent of the cancer risk associated with all currently identified toxic air contaminants (ARB, 10/18/2004, Staff Report, Proposed List of Measures to reduce Particulate Matter).

Backyard burning is another source of PM in the Sacramento area. Residential waste contains plastics, metals and synthetic materials that create dangerous chemicals when burned, including dioxins, benzene, PCBs (polychlorinated biphenyls) and other compounds that are known to cause respiratory ailments and are potentially carcinogenic.

Characterization of Ambient PM10 and PM2.5 in Sacramento

Particulate matter pollution is not one pollutant. It consists of a mixture of very small liquid and solid particles suspended in the air. Ambient PM is comprised of both directly emitted PM such as dust or soot, known as primary PM, as well as PM formed in the atmosphere from the reactions of precursor gases, known as secondary PM.

These precursor gases include nitrogen oxides (NO_x), sulfur oxides (SO_x) volatile organic compounds (VOC), and ammonia. NO_x, SO_x, and ammonia combine to form secondary ammonium nitrate and ammonium sulfate. VOCs can form secondary organic aerosols, as well as participate in the production of secondary ammonium nitrate.

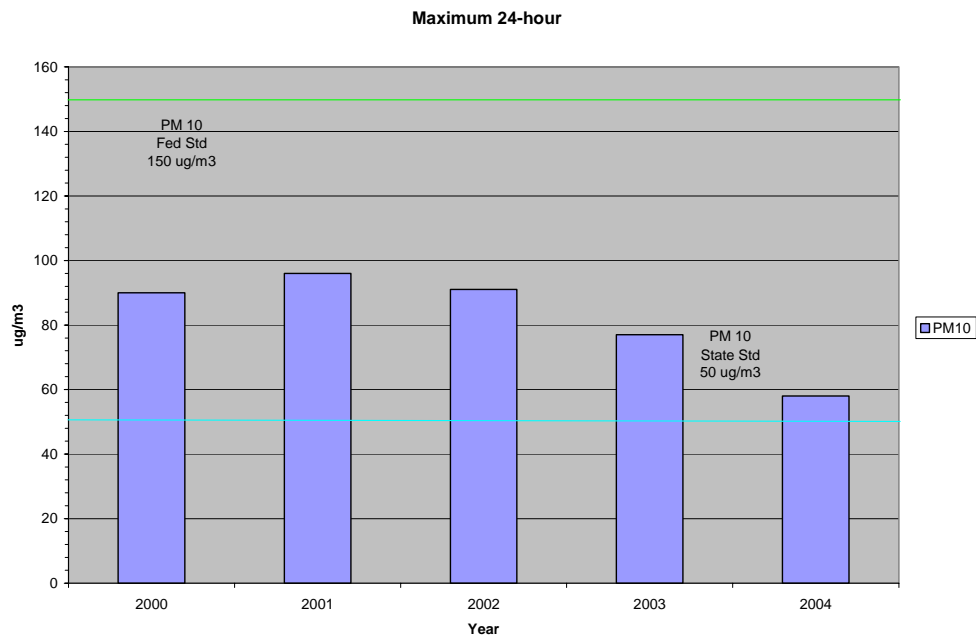
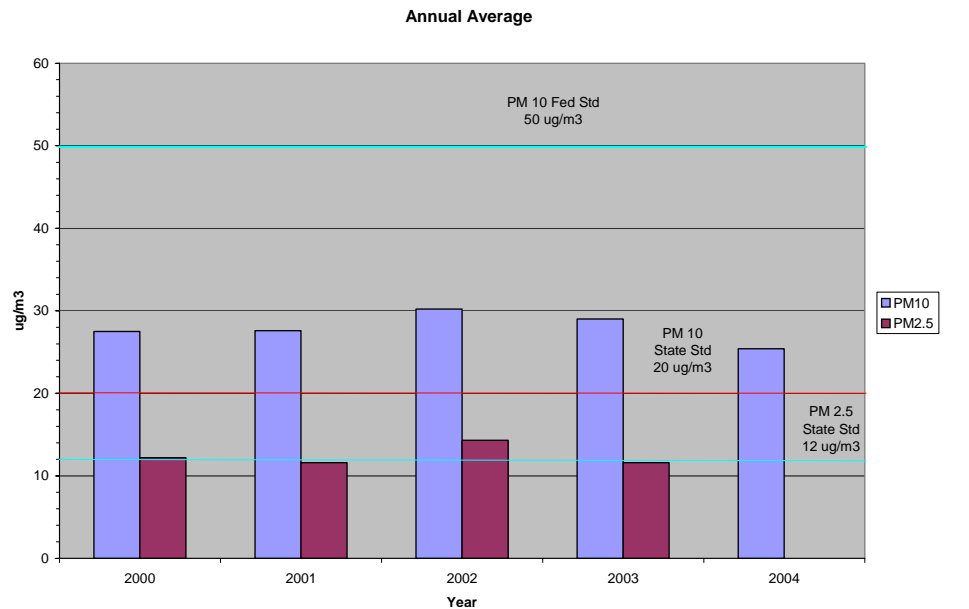
Ammonia emissions can also be a precursor to particulate concentrations. As was discussed above, ammonia combines with NO_x and SO_x emissions to form ammonium nitrate and ammonium sulfate, especially in the wintertime. Analysis¹ has been done to assess impacts from excess ammonia gas in the area of a new power plant emitting ammonia. CARB performed a simple mass balance on data from the 13th/T Street air monitoring station. The analysis suggested that Sacramento was ammonia-rich and increase ammonia would not increase PM

¹ "Appendix B-2 – SO_x for PM10 Interpollutant Trade Analysis, Final Determination of Compliance for SMUD Cosumnes Power Project, October 21, 2002"

levels. This suggests that ammonia reductions, unless they are very large, will not improve particulate levels.

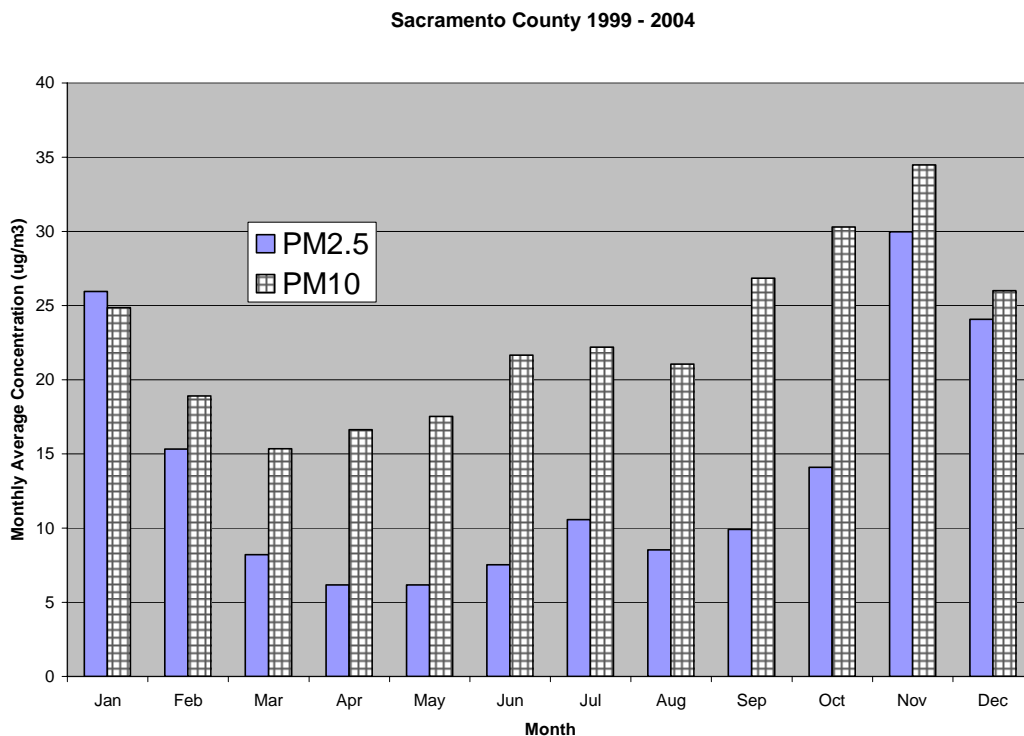
Nonattainment status

The charts below show the attainment status for state and federal standards for PM10 and PM2.5. There are two ambient air quality standards; an annual average for PM10 and PM2.5 and a 24 hour PM10 standard. Currently, there is only a federal 24 hour PM2.5 standard which Sacramento County has attained.



Seasonal variations

In the Sacramento area, there is a seasonal variation in PM, with higher PM10 and PM2.5 concentrations in the fall and winter months. A major contributor to high levels of ambient PM2.5 in this area in the winter is the secondary formation of ammonium nitrate from precursors emitted by stationary and mobile combustion sources. In the winter, PM10 and PM2.5 concentrations can remain elevated for extended periods. Increased activity for some emission sources (e.g. wood-combustion in stoves and fireplaces) and meteorological conditions are conducive to the buildup of PM. The figure below illustrates the monthly variation of the maximum daily PM10 and PM2.5 concentrations for both 2000 and 2004.



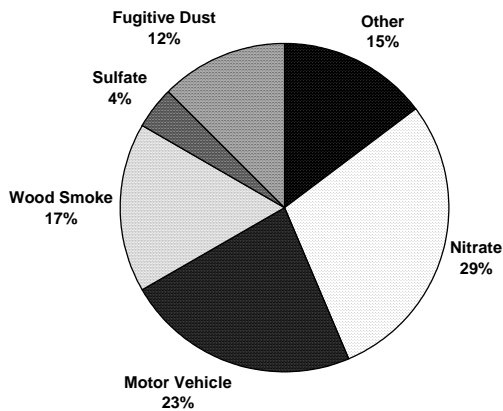
Source contributions from ambient monitoring data

District operates monitors to assess the various chemical species contributing to PM2.5. This data combined with chemical "fingerprints" for various emissions sources allows us to determine the relative contributions from the various sources on monitored air quality at the Del Paso Manor station. These analyses are called chemical mass balances (CMB). Similar data was gathered by CARB to assess various sources impact on PM10 levels. Staff has performed evaluations for the higher wintertime values, and is preparing a similar analysis of

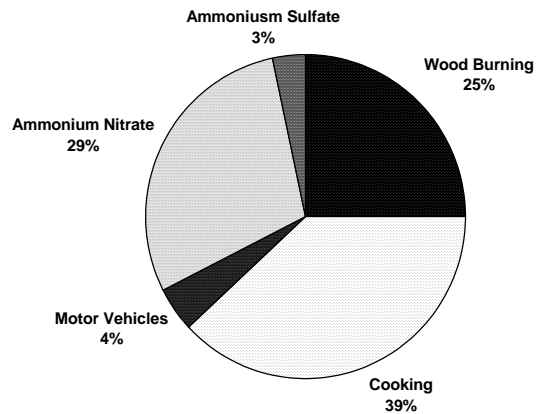
summer particulate data. Because the District has only one chemical speciation sampler, this represents values from the urban areas. The results in rural areas may differ.

Data for the illustrations below are from analysis of ambient air collected in Sacramento County for the winter from 1991 through 1996 for PM10 and from 2000 -2004 for PM2.5. The constituents shown can vary based on a variety of factors such as meteorology and which particulate sources are most active.

**PM10 Average Winter 1991-1995
CMB Source Estimate**



**PM2.5 Average Winter 2000-2004
CMB Source Estimate**



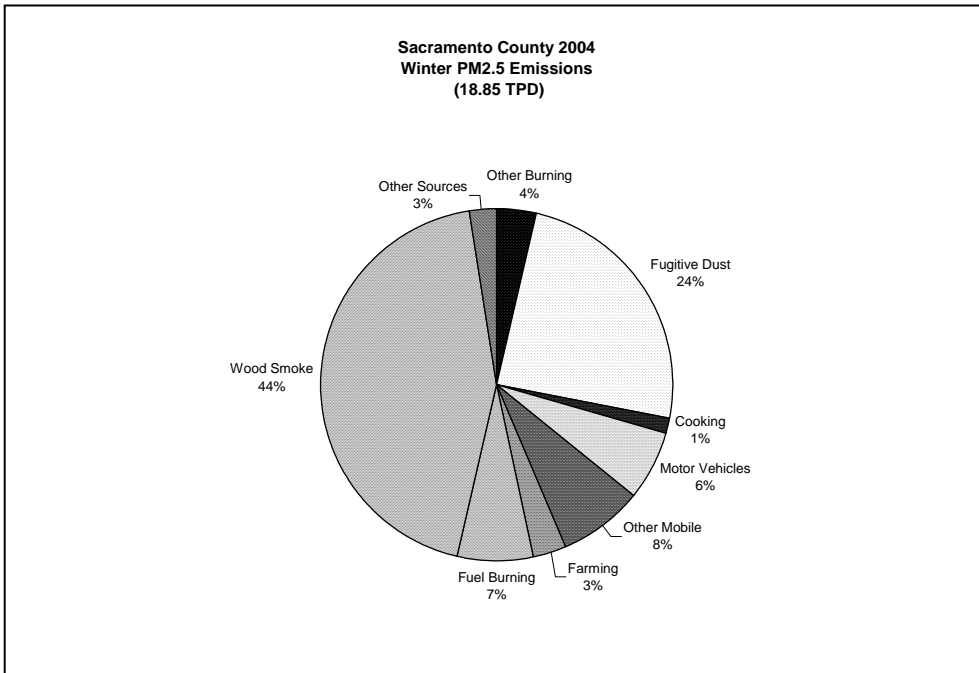
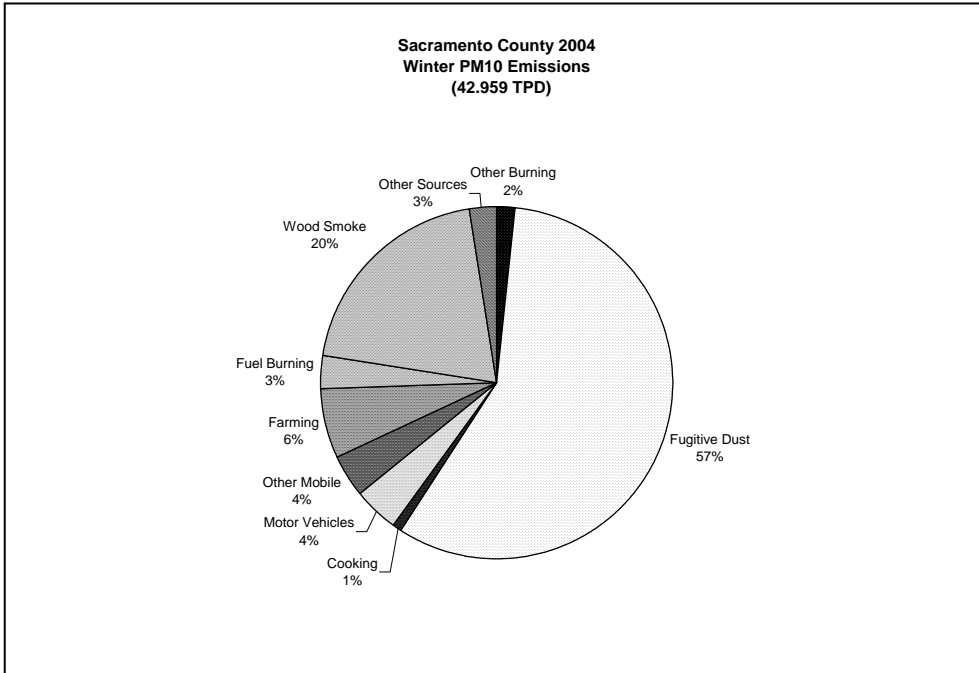
The data shows that during the winter wood smoke from residential fireplaces is a significant source of both coarse and fine particulate. In addition, for fine particulates, cooking is a significant contributor². Winter conditions – cool temperatures, low wind speeds, low inversion layers, and high humidity – also favor the formation of nitrates which is a secondary particulate that forms from combustions sources such as motor vehicles and other fuel combustion.

Emission sources

Sources of ambient PM include combustion sources such as trucks and passenger cars, off-road equipment, industrial processes, residential wood burning, and forest and agricultural burning; fugitive dust from paved and

² Note that cooking does not appear in the PM10 analysis. At the time that analysis was performed cooking was not evaluated. Cooking contributions likely appear in the "other" category.

unpaved roads, construction, mining and agricultural activities; and ammonia from sources such as livestock operations, fertilizer application, and motor vehicles. In general, combustion processes form fine particles, whereas emissions from dust sources tend to be coarse particles. An average winter day emission inventory for directly emitted PM2.5 and PM10 is summarized in the following pie charts.



Background of CARB List Development

As required by Senate Bill 656, CARB approved a list of the most readily available, feasible, and cost-effective control measures that can be employed by air districts to reduce PM at their November 18, 2004 Board meeting. The list is based on rules, regulations, and programs existing in California as of January 1, 2004, for stationary, area-wide, and mobile sources.

Potential List of Recommended Control Measures

SB656³ requires air districts to adopt implementation schedules for selected measures from the list by July 31, 2005. The implementation schedules will identify the appropriate subset of measures, and the dates for final adoption, implementation, and the sequencing of selected control measures. In developing the implementation schedules, each air district will prioritize measures based on the effect individual control measures will have on public health, air quality, and emission reductions and on the cost-effectiveness. Consideration is also given to ongoing programs such as measures being adopted to meet national air quality standards or the State ozone planning process.

Process for Evaluating Potential Control Measures

Staff is currently assessing the emission benefits and cost effectiveness of the various measures. Staff started with the recommended list of measures that was adopted by CARB in November 2004 and has amended that list for any measures that have been adopted since January 1, 2004. The list of measures that are still being analyzed for emission reduction impact and cost effectiveness are included in Attachment A. From the preliminary analysis of the ambient concentrations the potential control measures that will be focused on include wood burning, fugitive dust, agricultural operations, and additional measures for combustion sources and coating operations⁴.

Many of the control measures that were included on CARB's recommended list have already been adopted by the District or will already be recommended for commitment as part of the 2003 Triennial Report that the Board will be hearing later this year. Those measures are identified in Appendix B. There were also some measures that the District either has no sources or minimal emission inventory. Those measures are identified in Appendix C.

³ Health & Safety Code Section 39614(d)(1)

⁴ Health and Safety Code Section 39614(d) (3) precludes the implementation schedule from including measures "substantially similar" to measures already scheduled for adoption.

The current schedule for completing the assessment work and recommending a list PM control measures with implementation schedules is:

- Mid-April 2005 – Complete technical assessment
- May 2005 – Public Workshop on proposed list of measures and implementation schedule
- July 2005 – Board Hearing for adoption of the implementation schedules

Conclusion

Staff will be continuing to work to complete the analysis that is needed to identify the appropriate PM_{2.5} and PM₁₀ control measures needed for Sacramento County. This work will include looking at the summer day source apportionment, meteorological variations, continuing to refine emission profiles and completing statistical analysis of the data. This combined with the potential emission reductions and cost effectiveness of the measures will be used to recommend a list of measures to the District's Board of Directors at the July Board Hearing.

ATTACHMENT A
POTENTIAL SB656 CONTROL MEASURES

Strategy	Comment	Estimated Cost Effectiveness \$/ton
Wood-Burning Fireplaces and Wood-Burning Heaters		
Public Awareness Program		\$1,719 - \$12,060
Curtailment during periods with predicted high PM levels	May be mandatory or voluntary	
Require all specified wood-burning devices installed be U.S. EPA-Certified, Phase II or equivalent	Could include both wood-burning heaters and wood-burning fireplaces	
Number of Units	Limits the number of wood-burning fireplaces and wood-burning heaters that can be installed in new residential developments and nonresidential properties. Could also limit the number of additional units in existing properties.	
Replacement of non-certified appliances upon sale of property	Non-certified units need to be removed and scrapped.	
Control of wood moisture content		
Prohibits fuel types	Prohibits burning materials, such as household garbage, not intended for use in fireplaces and heaters	
Fugitive Dust		
Construction Earthmoving	Dust suppressants, prohibits visible dust emissions (VDE) beyond property line	\$56 - \$28,243
Construction Demolition	Dust suppressants, prohibits VDE beyond property line, track out limits	
Construction Grading Operations	Pre-watering, phasing of work, water application	
Inactive Disturbed Land	Restricts vehicle access, water/dust suppressants, prohibit beyond property line	
Bulk Materials Handling/Storage	Wind barriers, watering, prohibit VDE beyond property line	

Strategy	Comment	Estimated Cost Effectiveness \$/ton
Carryout and Track out	Track out removal, require manual sweeping	
Disturbed Open Areas	Water/dust suppressants to unvegetated area to limit VDE	
Paved Road Dust – New/Modified Public and Private Roads	Paved shoulders/medians	
Paved Road Dust – Street Sweeping	Use of certified PM10 efficient street sweepers by governmental agencies,	
Unpaved Parking Lots/Staging Areas	Limit VDE. Require water, gravel, dust suppressant, vegetative materials or paving or Fugitive PM10 Management Plan with requirements	
Unpaved Roads	Limit VDE. Require water, gravel, dust suppressant, vegetative materials or paving	
Weed Abatement Activities	Pre-watering, phasing work, stabilization requirements, restricting vehicle access	
Windblown Dust	Define windblown dust as any visible emission	
Windblown Dust – Construction/Earth Moving	For earthmoving, cease all operations, apply chemical stabilizers, stopping vehicular traffic	
Windblown Dust – Disturbed Area	Water application/chemical stabilization	
Windblown Dust – Bulk Materials/Storage Piles	Water application or temporary coverings	
Windblown Dust – Open Areas	50% vegetation cover or 75% of land area must be covered by water, or 4 inch gravel to areas that cause or contribute to federal PM10 exceedance	
Agricultural Operations		
Fugitive Dust from off-field ag sources	Fugitive Dust Management Plan	\$126 - \$447
Cease tilling/mulching when winds >25 mph		

Strategy	Comment	Estimated Cost Effectiveness \$/ton
Limit fugitive dust from paved and unpaved roads and livestock operations		
Reduce fugitive dust from livestock feed yards		
Combustion Sources		
Central Furnaces (NOx)	Set a NOx limit of 40 ng/joule for gas fired residential units with rating less than 175,000 btu/hr	
Commercial Charbroiling Operations (VOC, PM10, PM2.5)	Requires chain driven charbroilers to be equipped with a catalytic oxidizer control device	\$1,680 - \$6,800
Transportation Related Programs		
On-Road Motor Vehicle Mitigation Options	Requires employers who employ >249 employees to implement a program to reduce mobile source emissions generated from employee commutes and meet an annual emission reduction target for their worksite.	Not available
Transportation Outreach Program	Requires employers with >99 employees to register with district annually and collect survey data on commute distances and ridesharing participation every two years.	

ATTACHMENT B

CONTROL MEASURES EXCLUDED

**(DISTRICT ALREADY HAS ADOPTED
OR WILL BE PROPOSING AS PART OF
2003 TRIENNIAL PLAN)**

Strategy	Comment
Combustion Sources	
Measures reduce NOx, VOC, CO, ammonia, PM10 or PM2.5.	
Boilers, Steam Generators, and Process Heaters (NOx)	Rule amendments in progress, proposed commitment in the 2003 Triennial Report
Turbines (NOx, ammonia)	Rule already in place for NOx limits and all turbines <5 ppm. Ammonia reduction would not be large enough to affect PM concentrations.
IC Engines (NOx, VOC)	Rule amendments in progress, proposed commitment in the 2003 Triennial Report
Residential Water Heaters (NOx)	Rule amendments in progress, proposed commitment in the 2003 Triennial Report
Storage, Transfer, and Dispensing Operations	
Measures reduce VOC	
Gasoline Transfer and Dispensing Facilities	Rule already in place. No further amendments are needed.
Organic Liquid Storage	Rule amendments in progress, proposed commitment in the 2003 Triennial Report
Leaks and Releases	
Measures reduce VOC	
Equipment Leaks (Valves and Flanges)	A rule is already in place. A new rule amendment is in progress, proposed commitment in the 2003 Triennial Report
Product Manufacturing	
Food Product Manufacturing and Processing	Proposed further study measure in the 2003 Triennial Report
Pharmaceuticals and Cosmetics Manufacturing Operations	Rule already in place. No further amendments are needed.
Polyester Resin Operations	Rule already in place. Proposed further study measure in the 2003 Triennial Report.
Coating Operations	
Measures reduce VOC.	
Adhesives and Sealants	Rule already in place, proposed commitment in the 2003 Triennial Report.
Architectural Coatings	Rule already in place. Planned for

Strategy	Comment
	amendments as part of 8-hour ozone reduction commitment.
Glass Coatings	Will be regulated by proposed rule for unspecified coatings, proposed commitment in the 2003 Triennial Report
Graphic Arts	Rule already in place. No further amendments are needed.
Paper, Fabric, and Film Coating Operations	No sources in the District, these categories will be included in unspecified coating rule, proposed commitment in the 2003 Triennial Report.
Plastic, Rubber, and Glass Coatings	Will be regulated by proposed rule for unspecified coatings, proposed commitment in the 2003 Triennial Report.
Screen Printing Operations	Rule already in place. No further amendments are needed.
Vehicle Refinishing	Rule already in place, proposed further study measure in the 2003 Triennial Report.
Wood Products Coatings	Rule already in place. No further amendments are needed.
Solvent Cleaning and Degreasing Measures reduce VOC.	
Cleaning Operations	Rule already in place, proposed commitment in the 2003 Triennial Report.
Degreasing Operations	Rule already in place, proposed commitment in the 2003 Triennial Report.
Use of Solvents (VOC)	Rules already in place. No further amendments are needed.
Miscellaneous Measures reduce VOC, SOX, ammonia, or PM10 and PM2.5.	
Soil Decontamination (VOC)	Policy already in place. No further amendments are needed, no sources in the inventory.
Woodworking Operations (PM10)	Regulated under BACT and other visible emissions regulations. No further rules are required.
Solid Waste Landfills (VOC)	Sources already controlled by district rules. No further rule

Strategy	Comment
	revisions are required.
General Rules to Reduce Directly Emitted PM from Stationary and Area Sources	
These rules are generic and apply to sources that may not be regulated through a specific rule or permit requirement. The rules are intended to reduce directly emitted PM10 and PM2.5.	
Visible Emission Limits	Rule already in place
Combustion Contaminants (PM10, PM2.5)	Rule already in place
Grain Loading (PM10)	Rule already in place
Programs that Reduce PM Emissions from Mobile Sources	
Measures primarily reduce directly emitted PM10, PM2.5, NOx, and VOC.	
Incentive Programs (PM10, PM2.5, NOx) A funding source is needed in order to rely on incentives programs. <i>DMV Funds (AB 2766 Funds): Motor Vehicle Registration Fee Program (Many districts implement this program)</i>	Programs already in place. No further revisions are needed.
Heavy-Duty Engine Incentive Program Lower Emission School Bus Program Lower Emission School Bus Program Moyer Program Sacramento Emergency Clean Air Transportation (SECAT) Program Light and Medium Duty Vehicle Program Lawn Mower Buy Back Program Transportation Related Programs (PM10, PM2.5, NOx, VOC, CO) Transportation Outreach Program Spare the Air Program Public Awareness Programs Leveraging Other Sources for Transportation Funding	Programs already in place.
Transportation Related Programs	
Spare the Air	Program already in place
Public Awareness Programs	Program already in place
Leveraging Other Sources for Transportation Funding	Program already in place

APPENDIX C
REJECTED CONTROL MEASURES
(NO SOURCES OR MINIMAL EMISSIONS)

Strategy	Comment
Combustion Sources Measures reduce NOx, VOC, CO, or PM10 and PM2.5.	
Lime Kilns (NOx)	No sources in the District.
Cement Kilns (NOx, PM10, PM2.5)	No sources in the District.
Glass Melting Furnaces (NOx)	No sources in the District.
Composting and Related Operations Measures reduce ammonia and VOC.	
General Administrative Requirements	Negligible emissions inventory from this source category.
Chipping and Grinding Operations (Ammonia, VOC)	No sources in the District.
Composting (Ammonia, VOC)	Negligible emissions inventory from this source category.
Product Manufacturing Measures reduce VOC	
Coatings and Ink Manufacturing	No sources in the District.
Fiberboard Manufacturing	No sources in the District.
Polymeric Cellular Products (Foam)	No sources in the District.
Surfactant Manufacturing.	No sources in the District.
Coating Operations Measures reduce VOC	
Metal Container, Closure, and Coil Coating Operations	No sources in the District.
Magnet Wire Coating Operations	No sources in the District.
Marine Coating Operations	No sources in the District.
Metal Parts and Products	Limits VOC content, rule already in place, minimal reduction potential
Motor Vehicle Assembly Line Coating Operations	No sources in the District.
Spray Booth Facilities	No sources in the District.
Wood Flat Stock Coatings	No sources in the District.
Non-Agricultural Open Burning Measures reduce PM10, PM2.5 and as added benefit VOC, NOx, CO, and air toxics	Negligible inventory. Only 0.7% of PM2.5 inventory and 0.3% of PM10 inventory