

Appendix A: Top Ten Emission Sources by Pollutant

1. NO_x

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)	19.6

2. VOC

Emission Sources	2012 Emissions (Tons/Day)
Consumer Products	90.0
Light Duty Passenger Auto (LDA)	64.4
Off-Road Equipment	51.6
Light Duty Trucks (T1 & T2)	42.9
Petroleum Marketing	34.3
Recreational Boats	30.4
Medium Duty Trucks (T3)	21.2
Coatings and Related Process Solvents	18.8
Architectural Coatings and Related Solvents	18.8
Heavy Duty Gasoline Trucks	14.4

3. Directly Emitted PM_{2.5}

Emission Sources	2012 Emissions (Tons/Day)
Cooking	10.4
Residential Fuel Combustion	7.2
Paved Roads 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

4. SO_x

Emission Sources	2012 Emissions (Tons/Day)
RECLAIM	6.87
Ships and Commercial Boats (OGV & CHC)	4.57
Aircraft	1.43
Service and Commercial Fuel Combustion	1.15
Light Duty Passenger Auto (LDA)	0.85
Light Duty Trucks (T1 & T2)	0.51
Residential Fuel Combustion	0.49
Manufacturing and Industrial	0.43
Medium Duty Trucks (T3)	0.40
Petroleum Refining	0.36

Appendix B: Opportunities for Emission Reductions to Achieve PM_{2.5} Standards

This appendix describes control concepts toward achieving the federal PM_{2.5} standards if additional emission reductions are needed after implementation of other measures that achieve PM_{2.5} co-benefits and incentive programs as outlined in the PM White Paper. Examples of potential control concepts are discussed by sector. If additional reductions are needed for annual PM_{2.5} standard attainment, some or all of the concepts could be developed as a control measure that can be prioritized for implementation, including time and place controls, such as geographic, seasonal, or episodic controls, as well as incentive programs.

1. Cooking

The SCAQMD has implemented a very successful PM_{2.5} control program for chain-driven charbroilers (used at quick service restaurants), but PM_{2.5} emissions from under-fired charbroilers remain relatively uncontrolled, primarily due to the current high capital costs of equipment, and operation and maintenance (O&M) costs. Based on current emissions inventory, approximately 80% of PM_{2.5} emissions from restaurants are from under-fired charbroilers. SCAQMD is completing a study with University of California Riverside, in partnership with the U.S. EPA and other air agencies in PM_{2.5} nonattainment areas, to identify cost-effective and more affordable under-fired charbroiler controls. Types of devices being evaluated can be generally described as filter-based equipment, electrostatic precipitators (ESPs), catalysts, scrubbers, and other innovative technologies, some of which are nearing commercial availability. Study results are being evaluated and will be used to develop a detailed technical and economic (cost and affordability) feasibility analysis.

If needed for attainment, emission control programs for under-fired charbroilers could potentially be tiered and require high efficiency (and potentially more expensive) controls for larger restaurants and possibly less efficient, less expensive, yet more affordable equipment for smaller sources. Small business incentive programs could also be explored to help offset purchase and installation costs. For example, an incentive program could be explored to help offset the control device costs to restaurants from what could otherwise be less affordable controls for direct PM_{2.5} reductions at small business restaurants. The net result could be an overall reduction of PM_{2.5} pollution at a lower overall cost. SCAQMD continues to work closely with staff from the Bay Area AQMD, San Joaquin Valley APCD, and U.S. EPA Region 9 on research and demonstration projects for these control technologies.

2. Residential and Open Burning

Additional PM_{2.5} reductions from biomass burning were identified by the SB 656 (Sher) report and control measures were developed and implemented in conjunction with the 2007 and 2012 AQMPs. SCAQMD Rule 445 (Wood-Burning Devices) was adopted in 2008 and subsequently amended in 2013. Rule 445 established a mandatory residential wood-burning curtailment program, beginning in 2011, during winter months (November through the end of February) known as the “Check Before You Burn” program. Amendments in 2013 lowered the curtailment threshold from 35 (federal 24-hour PM_{2.5} standard) to 30 µg/m³ to address forecasting

uncertainties and assure a level of protection to remain below the standard. Rule 445 specifies the types of devices that can be installed into new and existing developments, includes moisture content requirements for commercial firewood sellers, and establishes a winter wood burning curtailment program. SCAQMD Rule 444 (Open Burning) has been in place since the formation of the SCAQMD and has been amended many times, most recently in 2013. Rule 444 is applicable to agricultural and prescribed (e.g., forest service) open burning sources and includes requirements to minimize smoke emissions. The 2013 amendments to Rule 444 synchronized the wintertime residential wood-burning control program (Rule 445) with the open burning program such that open burning would not occur during a mandatory residential no-burn day.

A new initiative has been implemented to upgrade wood-burning devices in inland, high PM_{2.5} areas. Under this program, households in the greater area surrounding the cities of Riverside and San Bernardino can work with participating retailers to choose from a variety of cleaner hearth products, including gas logs, gas/electric inserts, and more efficient wood stoves (if no gas service) for installation. SCAQMD provides incentives to offset purchase and installation costs. The incentives offered have been increased substantially over past programs and even higher incentives (up to \$1,600) are available for households that qualify under low-income guidelines. This program has been effective, but to achieve maximum emission reductions, higher incentives could be offered or the geographic area eligible to participate could be expanded. Experience has shown that education and outreach to targeted households is a key program component. Since the current eligible project area is relatively small, direct outreach to individual residences has been the most successful.

Potential additional emission reductions via Rule 445 residential wood burning could involve further restrictions on the types of devices (e.g., U.S. EPA certified wood burning devices) allowed to be installed into existing developments, such as room additions, remodels, etc.

The highest PM_{2.5} levels usually occur during late fall and winter months, with the exception of high values reported near the fourth of July (attributable to smoke from Independence Day firework displays). However, some high levels occur in early fall. If needed for attainment, further burn restrictions could be established for this fall time period by expanding the wintertime curtailment period to include October. The threshold used to forecast no burn days under either the residential or the open burning programs could also be lowered. Both options could reduce emissions during peak PM periods or episodes.

As previously mentioned, Rule 445 prohibits wood burning in areas where high PM_{2.5} levels are forecast. If poor PM_{2.5} air quality is, however, forecast for an area that has documented an exceedance of the federal 24-hour PM_{2.5} standard, the no-burn day applies to the entire Basin. This is intended to seek the maximum amount of emission reductions feasible in an attempt to prevent the episodic exceedance. The 2016 AQMP will address the annual PM_{2.5} standard which is less sensitive to these episodes. Currently, the peak PM_{2.5} monitoring site, or “trigger area”, to identify a Basin-wide curtailment day is in the Mira Loma area, part of Source Receptor Area (SRA) 23 (Metropolitan Riverside County). As part of an enhanced control effort, the trigger area could be expanded to include other SRAs with elevated PM_{2.5} levels that have not documented exceedances of the federal 24-hour standard (annual 98th percentile concentration, averaged over 3 years). This would likely result in an increase in Basin-wide no-burn days and

help to lower annual PM_{2.5} levels. Alternatively, if air quality modeling supported a truly targeted control program, there could be an increase in the number of no-burn days forecast solely for SRA 23 and immediate upwind areas.

Possible controls for Rule 444 open burning sources could include mandatory use of chipping/grinding or mulching as alternatives to open burning.

3. Fugitive Dust

PM derived from mechanical disruption (e.g., agriculture, construction, etc.) is primarily in the coarse (PM_{10-2.5}) size fraction; however, entrained road dust is still one of the major direct PM_{2.5} sources due to the region's large number of roadways and high traffic volumes. In response, SCAQMD has adopted regulations to prevent material from being deposited on roadways and a program for efficient street sweeping equipment. For the street sweeping equipment, a testing protocol was developed and minimum pick-up efficiency and entrainment standards are in place (Rule 1186 – PM₁₀ Emissions from Paved and Unpaved Roads, and Livestock Operations). Local jurisdictions must only procure equipment that meets applicable standards and a companion regulation (Rule 1186.1 – Less-Polluting Sweepers) also requires, in most cases, that street sweepers be powered by alternative fuels.

During the development of Rule 1186, SCAQMD staff learned that street sweeping frequencies vary greatly among jurisdictions, from weekly to monthly to, in some cases, not at all. If needed for attainment, minimum street sweeping frequencies could be explored as well as enhanced cleaning on roads with higher silt loadings.

4. Ammonia Control

1) Agricultural Dairies

Livestock waste is the third largest emission source of ammonia in the Basin and is regulated by both SCAQMD Rules 223 (Emission Reduction Permits for Large Confined Animal Facilities) and 1127 (Emission Reductions from Livestock Waste). Recent research found that fresh excreted manure in the animal housing areas is the major source of ammonia emissions and each cow produces approximately 60 kg of manure daily.¹ Prevailing winds push NO_x and SO_x emissions from industrial and transportation sources in the western Basin to inland areas and these gases mix with ammonia emissions from widespread sources, including approximately 100,000 head of dairy cattle and support stock in western Riverside and San Bernardino counties. Ammonium nitrate is the most prevalent PM compound measured at the Mira Loma air monitoring station, the only station projected to exceed federal 24-hour standard for PM_{2.5}.

If needed for attainment, seasonal or episodic approaches to control ammonia from dairy manure may be beneficial in reducing the secondarily formed air contaminants in the area. One possible approach would be to reduce ammonia emissions from fresh manure using an ammonia-reducing

¹ Final 2012 Air Quality Management Plan, Appendix IV-A, Control Measure BCM-04 – Further Ammonia Reductions from Livestock Waste, SCAQMD, February 2013.

agent. Sodium bisulfate, when dissociated, reduces the pH and protonates ammonia, converting it to ammonium. The ammonium is then bound by sulfate to form ammonium sulfate, which is retained in the manure in its solid form. In California, sodium bisulfate has been used by dairies in northern and southern counties, including San Bernardino and Riverside counties, mainly to prevent cow lameness and nuisance flies. Theoretically, 100 pounds (lbs) of sodium bisulfate would bind 14 lbs of ammonia. This method of control was initially proposed in the 2012 AQMP for an assessment to evaluate the technical and economic feasibility of application, including episodic application.

If deemed feasible and necessary, seasonal or episodic ammonia controls may be considered, for example by applying SBS to fresh manure during high PM_{2.5} months or for only days when higher concentrations occurred or are anticipated to occur based on the past analyses. However, costs associated with SBS use can be high and the need to offset the costs through an incentive program would need to be considered.

2) Anaerobic Digestion

The SCAQMD Rule 1133 series establish requirements for composting of organic waste such as animal manure, biosolids, greenwaste, and foodwaste. As ongoing efforts at the state level for organics diversion to meet AB 32 and landfill diversion goals, AB 341 (Chesbro) has created challenges relative to controlling VOC and ammonia emissions from increased composting of greenwaste, and increasingly foodwaste. AB 341 was approved by the legislature in 2011 to further reduce GHG emissions by diversion of organic materials away from landfills. This legislation established a goal that 75% of solid waste be reduced, recycled, or composted by 2020. This has created a statewide challenge to develop mechanisms to accommodate the state mandate while not adversely affecting air quality. Inclusive of these challenges are local air quality rules and regulations associated with composting operations/methods, permitting, and off-road vehicle use. Local air districts are working with CARB and California Department of Resources Recycling and Recovery (CalRecycle) to address these issues.

According to the composting industry², the majority of the yard trimmings and tree prunings processed (i.e., chipped and ground) in the Basin are not composted but go through a much shorter pathogen reduction process. These organic materials are used as an alternative daily cover (ADC) or for other beneficial uses at landfills or as a ground cover on commercial or public lands. The majority of mobile, point, and area source emissions from compostable materials handling through chipping and grinding are not sufficiently controlled to minimize potential emissions in the Basin. Conversely, composting is relatively well regulated through current air quality planning and rulemaking. Two legislative mandates, AB 1594 (Williams) and AB 1826 (Chesbro) approved in 2014 will help the state achieve diversion goals by 2020 through recycling of compostable organic waste materials. AB 1594 closes diversion credit for yard trimmings and prunings, including greenwaste, which is used as an ADC or for other beneficial uses at landfills. AB 1826 will drive the recycling of yard trimmings and food scraps by requiring commercial generators to sign up for composting or anaerobic digestion service for their organic waste. More organic materials are expected to be diverted in the future and consideration must be given to expansion of the organics processing industry and the emissions

² Paul Ryan, Inland Empire Disposal Association, E-mail communication, November 13, 2014.

impact from those processes and associated equipment compared to the overall benefits of diversion.

Anaerobic digestion (AD) has been identified as a technically viable method of organic waste treatment in which organic waste is transformed to renewable biogas, mainly composed of methane (CH₄) and carbon dioxide (CO₂), in an oxygen-free environment. Digesters can minimize emissions of ammonia, VOC, and other odorous pollutants in well-managed operating conditions, which can contribute to reductions of PM_{2.5} formation. However, air quality permitting, off-road vehicle use, as well as high capital investment and O&M costs, may be a disincentive. CalRecycle is in the process of amending and creating new requirements for California Code of Regulations, Titles 14 and 27 to address these and other implementation issues. As part of this process in particular, a stand-alone set of in-vessel digestion regulations has been proposed to divert compostable organic materials from landfills to reduce GHG generation, while producing biofuels or bioenergy. Use of digesters may bring about air quality benefits (e.g., decreasing GHG, ammonia, and VOC emissions) and co-benefits of PM_{2.5} reduction in the Basin.