

Technical Support Document

Area Source Control Measures

The area source BACM analysis consisted of a thorough review of the entire area source seasonally adjusted inventory for anthropocentrically derived direct PM_{2.5} and precursor constituents. There was no de minimis source category exemption in the review process instead, the analysis centered on whether control measures are technologically and economically feasible.

The BACM analysis was conducted based on:

- ❖ Literature review of EPA guidance documents and regulations including:
 - Control Techniques Guidelines (CTG)
 - Alternative Control Techniques (ACT)
 - New Source Performance Standards (NSPS)
- ❖ A comparison of existing rules to the CTG to assure that all appropriate CTG's have been addressed in rulemaking
- ❖ Ozone Transport Commission (OTC) model rules
- ❖ A comparison of other air districts rules (particularly those that are designated as serious nonattainment for PM_{2.5} and/or ozone) to Utah rules
- ❖ An evaluation of technological/economic feasibility for newly identified controls or enhancement of existing controls

Emission Reductions

Emission reductions are calculated as follows:

$$\text{Emission Reduction} = [\text{control efficiency (CE)} \times \text{rule effectiveness (RE)}] \times \text{rule penetration (RP)}$$

Control Efficiency (CE)

CE is a term that defines the expected emission reduction by implementing a rule. CE is normally derived from a CTG, however, some CTG's did not provide emission reduction information that could be used to derive the CE or the data is dated. In cases where the CTG cannot be accurately referenced, we derive our CE's from other sources, such as, the EPA database, AirControlNet and other state rulemaking background documentation.

Rule Effectiveness (RE)

RE is a term that describes a method to account for the reality that not all facilities covered by a rule are in compliance with the rule 100% of the time. RE also accounts for the fact that control equipment does not always operate at optimum control efficiency. Default RE is 80%. Higher values may be used based on source specific data.

Rule Penetration (RP)

Rule penetration is an estimate of the percentage of emissions emitted by sources covered by a rule. UDAQ has developed a matrix for RP as follows;

RP = 100% where a rule applies to all sources

RP = 98% where a rule threshold applies to sources that use at least 20 gallons but less than 1 ton/year

RP = 95% where a rule threshold is greater than 1 ton/year and for construction related emissions

Cost

The BACM analysis includes cost consideration. Cost was derived from a CTG, the EPA database AirControlNet, or from other state rulemaking documentation. Costs have been adjusted to 2016 dollars.

R307-201 Emission Standards: General Emission Standards

Discussion

Establishes general opacity requirements, no direct emission reduction taken in the SIP.

Estimated Cost

Unknown

R307-208 Outdoor Wood Boilers

Discussion

Outdoor wood boiler sales are prohibited in the nonattainment area. Units are subject to the solid fuel burning prohibitions during restricted burning periods.

Estimated Cost

The rule enforces the wood burning NSPS therefore, there are no state rule related costs.

Affected SCC

2104008610

Emission Reduction: PM_{2.5}, VOC, NO_x, SO_x

Refer to the discussion for R307-302

Salt Lake Nonattainment Area 61%

Provo Nonattainment Area 29%

Logan Nonattainment Area 51%

Reduction Schedule

From base year 2014 onward

R307-221 Emission Standards: Emission Controls for Existing Municipal Solid Waste Landfills

Affected SCC

2620030000 Landfill

Estimated Cost

Unknown – based on federal requirements

Emission Reduction

98% VOC reduction, actual emissions, inclusive of control reported by landfills

R307-230 NOx Emission Limits for Natural Gas-Fired Water Heaters

Emission Reduction

SCC 21004006 Residential

40 to 10 ng/Joule= 75% NOx reduction

Residential appliance apportionment: each home has at least 1 furnace and 1 water heater. Many Utah homes have gas fireplaces. Gas usage apportionment: 45% furnace, 45% water heater and 10% fireplace (Questar Gas confirmed reasonable gas usage apportionment assumption)

Residential NOx reduction for water heaters: $(75\%)/2.22 = 33.8\%$ = Control Efficiency

RE- 100%, statewide requirement

RP- average lifetime of water heater 10 yrs= $(33.8\%)/10 = 3.38\%/yr$ for 10 years

SCC 2103006 Institutional

40 to 14 ng/Joule= 65% NOx reduction

Appliance apportionment: 1 furnace and 1 water heater: $(65\%)/2 = 32.5\%$

Control Efficiency

RE- 100%, statewide requirement

RP- average lifetime of water heater 10 years= $(32.5\%)/10 = 3.25\%/yr$ for 10 years

Reduction Schedule

The rule implementation date was July 1, 2018. Emission reductions will be from 2018-2028.

Estimated Cost

SCAMD cost analysis reported at board meeting date: December 10, 1999 agenda No. 26A: "cost increase of manufacturing a low-NOx water heater is expected to range between \$3 and \$50 per water heater, depending on technology and the emission limit. Cost estimates do not include savings due to lower gas usage...Based on an emission limit of 10 ng/J, the cost-effectiveness in 2005 is \$4,400 to \$16,000 per ton of NOx reduced. The cost-effectiveness for the 2005 emission limit is based on a ceramic burner technology and is expected to be closer to the lower end of the range."

The 2016 adjusted value for residential water heaters would be \$5,407/ton of NOx removal.

R307-302 Solid Fuel Burning Devices

Discussion

24-hr PM_{2.5} samples were collected during winter 2016 at 4 different sites: Smithfield, Brigham City, Hawthorne and North Provo. Samples were analyzed for levoglucosan, which is a unique tracer for biomass burning. Considering that wildfires and prescribed burns are minimal in winter, the main biomass burning source in these areas is assumed to be residential wood-burning. Sampling days included days with a ban on wood-burning and days with no burning restriction. Current regulations include a voluntary and mandatory restriction on wood-burning when wintertime PM_{2.5} levels reach 15 and 25 µg/m³, respectively. Given the limited number of samples (≤ 3) on voluntary no-burn days, only results for mandatory no-burn days and no-ban days are shown.

Levoglucosan concentrations varied between burn and no-burn days, with higher or comparable levels on mandatory no-burn days compared to days with no wood-burning restriction (Figure 1). This can be attributed to decreased atmospheric mixing on mandatory no-burn PM_{2.5} days combined with wood-burning activity.

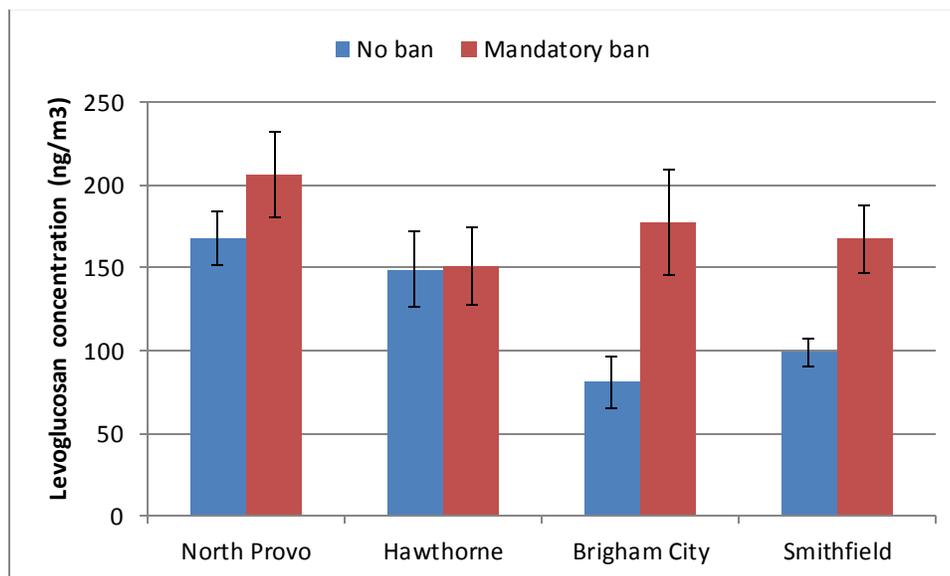


Figure 1. Levoglucosan concentrations during no-ban days and mandatory no-burn days at North Provo, Hawthorne, Brigham City and Smithfield. Error bars represent standard error.

To control for the variation in atmospheric stability conditions, levoglucosan concentrations were normalized by the heat deficit, H , which is a measure of atmospheric stability (Whiteman et al. 2014):

$$H = C_p \int_0^h \rho(z) [\theta_h - \theta(z)] dz \quad [J \cdot m^{-2}]$$

where h is the height of the surrounding mountain ridge above the valley floor, C_p is the specific heat for air at constant pressure, ρ_z is the air density at height z , θ_h is the potential temperature at ridge height and $\theta(z)$ is the potential temperature at height z .

The heat deficit, H , was calculated using twice-daily rawinsonde soundings (0500 and 1700 MST or 1200 and 0000 UTC, respectively) acquired from the University of Wyoming database at the Salt Lake City international airport (<http://weather.uwyo.edu/upperair/sounding.html>).

Following normalization by the heat deficit, levoglucosan concentrations on mandatory days dropped below those observed on days with no burning restriction (Figure 2). Levels on mandatory no-burn days, however, were non-negligible, suggesting the occurrence of wood-burning activity on mandatory no-burn days. This is also confirmed by continuous brown carbon measurements conducted with a 7-wavelength aethalometer by the University of Utah during winter 2016.

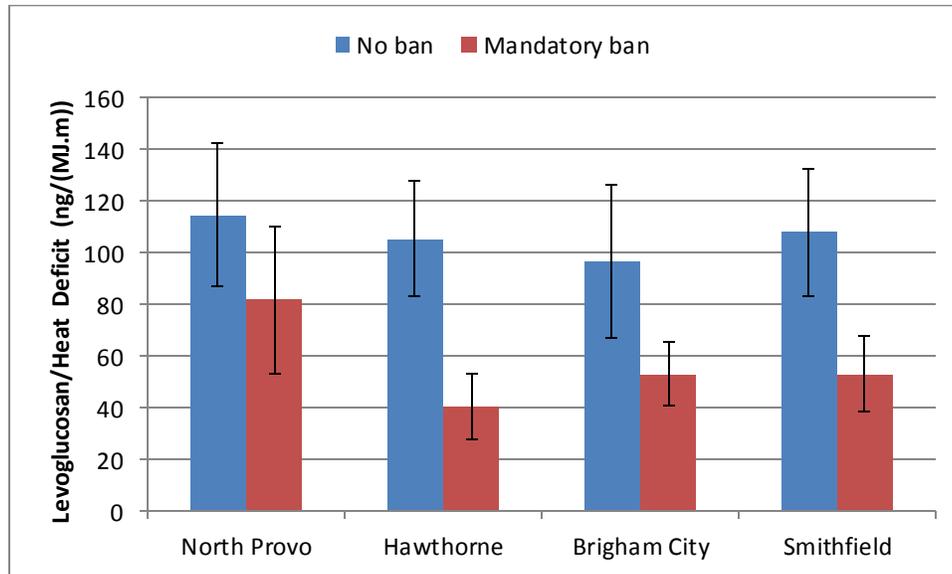


Figure 2. Normalized levoglucosan concentrations by heat deficit during no-ban days and mandatory no-burn days at North Provo, Hawthorne, Brigham City and Smithfield. Error bars represent standard error.

Using the normalized levoglucosan measurements, the compliance rate with the wood-burning ban was estimated as follows:

$$Compliance\ rate = 1 - \frac{C_{no-burn\ day}}{C_{no-ban\ day}}$$

where $C_{no-burn\ day}$ and $C_{no-ban\ day}$ correspond to normalized levoglucosan concentration on mandatory no-burn and no-ban days, respectively.

This yields a compliance rate of ~61, 51, 29 and 45% in Salt Lake, Cache, Utah and Box Elder counties, respectively, where measurements at each sampling site are assumed to be representative of their respective counties. It is noteworthy that this analysis is associated with several uncertainties, such as assuming that residents maintain similar wood-burning practices/activity on mandatory no-burn days and days with no wood-burning restriction. Nonetheless, despite these uncertainties, the calculated compliance rates provide a more realistic estimate than previously assumed values.

References

Whiteman C. D., S. W. Hoch, J. D. Horel, A. Charland. Relationship between particulate air pollution and meteorological variables in Utah's Salt Lake Valley. *Atmospheric Environment*, 94 (2014), 742-753.

Estimated Cost

The rule enforces the wood burning NSPS therefore, there are no state rule related costs

Affected SCC

2104008320,2104008310,2104008330,2104008400,2102008000,2104008100,210300800
2104008610,2104008210,2104008220,2104008510,2104008230,2104008700

Emission Reduction: PM2.5, VOC, NOx, SOx

Salt Lake Nonattainment Area 61%

Provo Nonattainment Area 29%

Logan Nonattainment Area 51%

Reduction Schedule

Pre-base year of 2014 onward

R307-303 Commercial Cooking**Discussion**

UCAIR and UDAQ negotiated a discounted purchase of catalytic converters from a dealer and assisted the Burger King's to install the units.

Actual Cost:

Catalysts: \$1,400/unit

Catalysts life expectancy per manufacturer: 7 yrs

Conveyerized hamburger cooking:25 lbs combined emissions/500 lbs of meat (ASHRAE 1375-RP, final report)

Average Burger King meat throughput: (500 lbs/month) (12 months)= 6,000 lb/yr of meat

Total uncontrolled emissions: (3tpy) (7yrs)=21 tons combined emissions

Total controlled emissions: (21 tons) (0.80 CE)=16.8 tons

Unit maintenance is routine cleaning-not included in costing

Cost: \$1,400/16.8 tons= \$83/ton removed

Affected SCC

2302002100 Chain-driven

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC and PM2.5	80	95	100	76

CE- from SCAQM Rule 1138, considered a conservative estimate

RE- catalysts are activated as soon as optimum exhaust temperature is reached. Meat is placed onto the conveyer when the broiler is at full operating temperature, when the catalysts are activated, the RE is reasonably assumed to be at least 95%.

Reduction Schedule

Installations were made in 2016, continuous reductions

R307-304 Solvent Cleaning

Affected SCC

2415 Solvent Degreasing

Emission Reduction

Solvent Cleaning Category	VOC Limit (gram/Liter)	% Reduction
Coatings, adhesives and ink manufacturing	500	44
Electronic parts and components	500	44
General miscellaneous cleaning and solvent use	300	67
Medical devices and pharmaceutical <ul style="list-style-type: none"> • Tools, equipment and machinery • General surface cleaning 	800 600	11 33
Screening printing operations	500	44
Semiconductor tools, maintenance and equipment cleaning	800	11
Average		36

Average density for a typical VOC cleaning solvent = 900 grams/liter
(EPA 453/R-06-001, September 2006)

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	36	80	98	28

Nonattainment Inventory (TPY)

Salt Lake	1142.64
Provo	200.11
Logan	101.33
Total	(1444.08) (28% reduction)= 404 tpy removed

Estimated Cost

EPA's 2006 guidance on industrial solvent cleaning estimates that annual costs for aqueous-based parts cleaning is \$1,762 (in 2016 dollars). This cost does not account for any specialized equipment that may be necessary.

Reduction Schedule

phase-in reductions from 2018 over 5 yrs.

R307-307 Road Salting and Sanding

Discussion: the rule requires the use of 92% soluble salts use or vacuum sweep every arterial roadway (principal and minor) to which the material was applied within three days of the end of the storm for which the application was made. Salts and or salt slurries are commonly used. UDAQ field studies have shown that the salts wash away leaving minimal PM behind.

Emission Reduction: no direct emission reduction taken in the SIP.

Estimated Cost: no additional control measure cost beyond traditional practice.

R307-309 Fugitive Emissions and Fugitive Dust

Estimated Cost: \$2,140/acre derived from actual source data

Emission Reduction

Construction: 262003,231102,2325,231103,231101

	CE(%)	RE(%)	RP(%)	% Reduction
PM2.5	37	90	95	32

CE-AirControlNet, May 2006, page III-700

RE=above default value based on high compliance, validated by the nearly 1,000 dust control plans filings received by automated program

2325 Mining and Quarrying

	CE(%)	RE(%)	RP(%)	% Reduction
PM2.5	40	100	95	38 of 2% of operations*=0.076

CE-AP 42 Appendix B-2, Section B-2.3

RE=Sources are nearly all permitted units that are routinely inspected due to public interest in reducing blowing dust.

*Control affects 2% of mining and quarrying emissions. This proportional adjustment is from 2014 EPA/NOMAD mining and quarrying tool for the nonattainment counties

R307-312 Aggregate Processing Operations

Estimated Cost: Neutral cost

Affected SCC

2325000000

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
PM2.5	0.569	95	100	0.54

Note: CE values derived from direct source permit calculations
RE-90%, all major point sources frequently inspected

Reduction Schedule

Starting in 2014

R307-328 Gasoline Transfer and Storage

Discussion: This rule establishes control of gasoline vapors during the filling of gasoline cargo tank and storage tanks. The rule is based on federal control technique guidance documents.

Emission Reduction: no direct emission reduction taken in the SIP

R307-335 Degreasing

Estimated Cost: \$1,640/ton VOC removed

Affected SCC

2415 Solvent Degreasing

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	31	80	100	25

CE- AirControlNet page III-1391

R307-341 Cutback Asphalt

Discussion: this rule limits the amount petroleum in the asphalt. The rule has been in place since 2007. No direct emission reduction taken in the SIP.

R307-342 Adhesive and Sealants

Estimated Cost: \$380/ton(Control Techniques Guidelines for Miscellaneous Industrial Adhesives VOC EPA 453/R-08-006)

Affected SCC

2460600000

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	64	80	100	51

CE- EPA 453/R-08-006

Reduction Schedule

Rule became effective 2014, 5 year phase-in based on work with local manufacturer and time to exhaust pre-rule manufactured inventory.

R307-343 Wood Furniture Manufacturing

Estimated Cost: \$2,616/ton VOC removal

Affected SCC

2401020000 Surface Coatings, Wood Furniture

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	82	80	98	64

CE - EPA- 453/R-96-007

Reduction Schedule

Training program, in collaboration with manufacturers, on new coating application began in 2016 when distributors began to see source purchases of compliant coatings. Assume 5 yr phase-in period starting in 2018 based on industry input.

R307-344 Paper, Film and Foil Surface Coating

Affected SCC

2401030000 Surface Coatings, Paper, Film, and Foil

Estimated Cost

\$1,878/ton VOC removal

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	90	80	98	71

CE- EPA 453/R-07-003

Reduction Schedule

Assume 5 yr phase-in period starting in 2018 based on industry input.

R307-345 Fabric and Vinyl Surface Coating

Affected SCC

2401090000 Other

Estimated Cost

\$3,658/ton VOC removal

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	60	80	98	47

CE- EPA 450/2-77-008

Reduction Schedule

Assume 5 yr phase-in period starting in 2018 based on industry input.

R307-346 Metal Furniture Surface Coating

Affected SCC

2401025 Surface Coatings, Metal Furniture

Estimated Cost

\$2,482/ton VOC removal

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	35	80	98	27

CE- EPA 453/R-07-005

Reduction Schedule

Assume 5 yr phase-in period starting in 2018 based on industry input.

R307-347 Large Appliance Surface Coating

Affected SCC

2401060000 Surface Coatings, Appliances

Estimated Cost

\$2,482/ton VOC removal

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	30	80	98	24

CE - EPA 453/R-07-005

Reduction Schedule

Assume 5 yr phase-in period starting in 2018 based on industry input.

R307-348 Magnet Wire Surface Coating

Affected SCC

2401065000 Surface Coatings, Electrical

Estimated Cost

\$6,857/ton VOC removal

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	36	80	98	28

CE- AirControlNet Page III-1332

Reduction Schedule

Assume starting in 2018 based on industry input.

R307-349 Flat Wood Surface Coating

Affected SCC

2401015000 Finished Wood

Estimated Cost

\$2,680/ton VOC removal

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	34	90	98	30

CE- EPA 453/R-06-004

Reduction Schedule

Assume 5 yr phase-in period starting in 2018 based on industry input.

R307-350 Miscellaneous Metal Surface Coating

Affected SCC

2401055000 Machinery
2401070000 Other Transportation
2401200000 Special Maintenance

Estimated Cost

\$2,111/ton VOC removal

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	35	90	98	31

CE- EPA-453/R-08-003

Reduction Schedule

Assume 5 yr phase-in period starting in 2018 based on industry input.

R307-351 Graphic Arts Surface Coating

Affected SCC

2425000000 Graphic Arts

Estimated Cost

\$4-5,000/ton VOC removal, per Gary Jones at the American Printing Association

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	69	90	98	61

CE- 65% AirControlNet pg. III-1340 + 4% from 2017 amendment

Reduction Schedule

Assume 3 yr phase-in period starting in 2018.

R307-352 Sheet, Strip, Coil and Container Surface Coating

Affected SCC

2401045000 Surface Coatings, Sheet, Strip & Coil
2401040000 Metal Containers

Estimated Cost

\$3,369/ton VOC removal

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	42	80	98	33

CE- BAAQMD Rule 11, amended June 1999

Reduction Schedule

Assume 5 yr phase-in period starting in 2018 based on industry input.

R307-353 Plastic Parts Surface Coating

Affected SCC

2401090000, Surface Coatings, Other

Estimated Cost

\$2,111/ton VOC removal

Emission Reduction

VOC	CE(%)	RE(%)	RP(%)	% Reduction
	35	80	98	27

CE- EPA-453/R-08-003

Reduction Schedule

Assume 5 yr phase-in period starting in 2018 based on industry input.

R307-354 Autobody Refinishing

Affected SCC

2401005000 Autobody Refinishing

Estimated Cost

\$2,864/ton VOC removal

Emission Reduction

VOC	CE(%)	RE(%)	RP(%)	% Reduction
	93	80	98	73

CE – AirControlNet page III-1317

Reduction Schedule

Assume 5 yr phase-in period starting in 2016 based on UCAIR grant program initiation to support the industry.

R307-355 Aerospace Manufacture and Rework Facilities

Affected SCC

2401075000 – Aircraft

Estimated Cost

Unknown, assume \$3,672/ton based default cost for reformulation (\$2,000/ton used in the 1990's adjusted for inflation to 2016).

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	60	80	95	46

CE – EPA Moderate SIP comments

Reduction Schedule

Assume 5 yr phase-in period starting in 2018 based on major source inspection.

R307-356 Appliance Pilot Light.

Affected SCC

2104006000 Combustion, Natural Gas, Residential

Estimated Cost

Neutral cost from fuel saving

Appliance Type Apportionment

Gas stoves/ranges: Most (even low end units) come with electronic ignition. It is assumed that pilot lighted ignition units are no longer marketable = 0%

Furnaces: Each home has at least one and is the predominate appliance in the home. Life expectancy is 20 years. Repairs are favored over replacement due to replacement cost. Electronic ignition has become popular in recent years. Because of their longevity and recent conversion to electronic ignition, it is assumed that all heaters use pilot light ignition that will be phased out in 10 years. Apportionment=40%

Water heaters: Each home has at least one and is the other predominate appliance in the home. Apportionment= 40%.

Gas fireplaces: 20%, pilot ignition is still common. It is assumed that all units are pilot ignition.

Reduction

40% furnaces

20% fireplaces

60% rule applies to gas usage

48% of gas use in fireplaces is from pilot light when used year round. Assume the same for all appliance types. *Fireplace Pilots Take Gas Use SkyHigh, Home Energy Magazine, January/February 1997.*

100% rule effectiveness applying 48% reduction phased in over 10 year life span of typical appliance (rule penetration): 2014 – 2024, 4.8%/year of 60% of inventory for VOC, PM2.5 and SO_x.

R307-357 Consumer Products

Estimated Cost

\$3090/ton VOC removed

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	48	100	100	48

CE- personal communications with CARB

Affected SCC

Category	A. Percent Products in Rule	VOC Category Credit in Percentage (B) (A) x (48%)
2460100000 Personal Care Products	17	8.4
2460200000 Household Products	51	24.5
2460400000 Auto Aftermarket Products	13	6.4
2460500000 Consumer Use Solvents	18	8.7
Total		48

Reduction Schedule

Implemented 9/2014, average shelf life 3-yrs to exhaust inventory, assume first product hit shelf starting 2016.

R307-361 Architectural Coatings

Affected SCC

2401001000

Estimated Cost

According to AirControlNet, the initial cost for the OTC model rule was \$6,628/ton VOC reduced. Since most of that cost has already been realized in previous years, it is reasonable to assume that the cost to implement the OTC 2011 model rule was substantially lower.

Emission Reduction

	CE(%)	RE(%)	RP(%)	% Reduction
VOC	55	100	100	55

CE- personal communications with CARB

Reduction Schedule

Implemented 2014, average shelf life 1-yrs to exhaust inventory, assume first product hit shelf starting 2016.