APPENDIX C

REGIONAL-SCALE MODELING SUPPLEMENTARY INFORMATION

Appendix C. Regional-scale Modeling Supplementary Information

1. Characterization of the Technology Mix

The mix of emission control options that staff assumed for the revised scenario in Section 4.2.1 includes NO_2-generating filters, non-catalyzed filters, flow-through filters, diesel oxidation catalysts (DOCs), and engine repowers or vehicle/equipment replacements. The first two are Level 3 systems (85 percent or more PM reduction) based on wall-flow filter technology. The NO_2-generating filters include both passive and active filters that use a substantial amount of precious metal catalyst. The non-catalyzed filters require external energy input to regenerate (active filters) and do not increase NO_2 emissions. Flow-through filters are Level 2 systems (50 percent or more PM reduction) that have a variety of substrate designs that generally induce some amount of turbulence and partially filter the exhaust. They are typically less heavily catalyzed than conventional passive filters, but have a greater loading than typical DOCs, which are Level 1 systems (25 percent or more PM reduction). Like passive filters, flow-through filters will typically increase NO_2 emissions, but to a lesser degree. The repower or replace option (Level 3 PM reduction) involves either installing a new engine or a piece of equipment into an existing vehicle or replacing an existing vehicle with a new one. Although several retrofit systems achieve NOx reductions in addition to PM (such as exhaust gas recirculation, selective catalytic reduction, and lean-NOx catalyst systems), staff only assigned NOx reductions to the repower/replace option to be conservative. Performance assumptions for the key pollutants are shown in Table C-1.

Table C-1. Control Technology Performance Assumptions

Control option	Emissions Reductions*				
	NO_2**	PM	HC	NOx	CO
NO_2-generating filters	-300%	85%	90%	0%	90%
Non-catalyzed filters	0%	85%	0%	0%	0%
Flow-through filters	-200%	50%	70%	0%	70%
Diesel oxidation catalysts	0%	25%	50%	0%	50%
Repower/Replacement	0%	85%	90%	75%	90%

*Reductions of total carbonyls, formaldehyde, acetaldehyde, benzene, total polyaromatic hydrocarbons (PAH) and nitro-PAH are all taken to be commensurate with the HC and CO reductions.
**Negative values represent emissions increases.

2. Background on the Air Quality Model

Staff used the Comprehensive Air Quality Model with Extensions (CAMx) by ENVIRON with the SAPRC99 photochemistry to simulate the regional air quality impacts of staff's proposal[1]. The model used the meteorological conditions from the August 3-7, 1997, ozone episode. These conditions are conducive to ozone formation and were used in the 2003 South Coast SIP update. The modeling region covers most of Southern California. The region is divided into 100 east-west by 74 north-south 5 kilometer cells. Details of this modeling episode and baseline inventory can be found on the South Coast Air Quality Management District's website: http://www.aqmd.gov/aqmp/AQMD03AQMP.htm.

3. Additional Discussion on Table 5

Staff used modeled percent changes from baseline concentrations to estimate the annual premature deaths avoided from reducing $PM_{2.5}$ and ozone in the South Coast Air Basin. Three to five episode days were modeled on a regional scale for ozone, reflecting high and moderate ozone levels. In contrast, only two episode days were modeled for $PM_{2.5}$. Annual total health impacts due to $PM_{2.5}$ and ozone exposures above background (assumed to be 2.5 micrograms per cubic meter for $PM_{2.5}$ and 40 ppb for ozone) were calculated using standard methodologies outlined in the ARB staff reports for both standards. The percent changes in premature deaths were then applied to the total deaths. Premature death is the focus of this health impacts assessment because it has the greatest economic valuation among all health effects from air pollutant exposures. Note that regional-scale modeling results probably underestimate the benefits of reductions of near-source exposures to diesel PM. Also, assuming the percent changes based on limited modeled days would occur on all days in the year may not be true; however, it was necessary for staff to make this assumption to estimate the annual health impacts. The ranges shown for the avoided death estimates in Table 5 indicate the range of results from multiple episode days. In addition, there is a plus or minus 50 percent uncertainty behind each estimate due to the uncertainty in the concentration-response relationships between air pollution exposure and premature death.

4. Additional Discussion on Table 6

Staff used several parameters to show the impact of the different retrofit scenarios on ozone. The modeling domain covers most of Southern California and is composed of 5-kilometer square grid cells. Peak 1-hour ozone is the highest 1-hour averaged concentration out of all the cells in the modeling domain. Peak 8-hour ozone is similar, except that concentrations are averaged over an 8-hour period and so tend to be lower. Simulated changes for both are quite small for the revised scenario (about 1 percent). For reference, the baseline peak 1-hour ozone concentration is 146.6 ppb and the increase for the revised scenario is 1.1 ppb for a total of 147.7 ppb.

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[1] The modeling conducted at the time of the adoption of the verification procedure in 2002 used the Calgrid photochemistry model.

Exposure in a given cell is the product of the cell's population and the time-averaged concentration above some threshold. The cumulative daily 1-hour exposure over 90 ppb is the sum of exposures for all cells for each of the 24 hours in a day. One cell can therefore contribute as many as 24 numbers to overall exposure. The maximum daily 8-hour exposure over 70 ppb, however, is based on the single, maximum 8-hour concentration over 70 ppb that occurs in a day for each cell. Therefore, one cell can contribute a maximum of one number to overall exposure. The changes in the 1-hour and 8-hour exposures are different because the metrics are defined quite differently.