
NET VEHICLE EMISSIONS RESULTING FROM COMMUTER RAIL SERVICE

XII

A. Chapter Summary

Replacement of SOV commuting with VRE use has air quality benefits. Reductions in SOV miles traveled translate into less vehicle emissions. The VRE Ridership Survey provided some preliminary information from which mileage reductions could be calculated. The mileage calculations could then be used as data inputs for an air quality model assessment. The results of this process must be understood to be both *preliminary* and *generalized*. The survey data on which they are based were not designed to elicit specific air quality model input.

Based on the derived model input data, MOBILE 4.1 model analysis showed that the net result of VRE operations and ridership use resulted in a decrease of nine tons of carbon monoxide (CO) emissions, a reduction of 0.4 tons in the controlling pollutant of volatile organic compounds (VOCs) emitted, and a gain of 0.6 tons of nitrogen oxide emissions over pre-VRE conditions for the day the VRE ridership was surveyed. The results show that increasing the ridership on the VRE produces positive air quality benefits by removing vehicles, especially SOVs, from the study area highways. The generalized air quality estimates may help local officials better determine a role that commuter rail service can play in helping achieve regional air quality programs, as well as in congestion relief programs.

B. Methodology for Converting Survey Results into Model Inputs

The Washington Air Quality Attainment Area—comprising Washington, DC, and large parts of surrounding Maryland and Northern Virginia—is classified as a non-attainment area for exceeding ozone standards every year since 1980. Federal health standards are exceeded when air contains more than 0.120 parts per million of ozone, averaged over one hour, for more than one occurrence per year. Violation days have ranged from a low of two in 1986 and 1992, to a high of 26 in 1988.⁷⁹ The number of annual violation days has averaged 10.25 since 1980. The Clean Air Act Amendments of 1990 (CAAA) require that the metropolitan region significantly improve its air quality.

Nitrogen oxide (NO_x) and volatile organic "hydrocarbon" compounds (VOCs or HCs) are the two pollutants which contribute to ozone (O₃) formation. According to Blumenthal, ozone

...is a poisonous form of pure oxygen and the principal component of modern smog...Ozone and other oxidants...are not emitted into the air directly. They are formed by chemical reactions in the air from two other pollutants, hydrocarbons and nitrogen oxides. Energy from sunlight is needed for these chemical reactions...⁸⁰

Ozone attacks synthetic rubbers and the cellulose in textiles. The oxidant components cause severe eye irritation, and in combination with ozone, they can irritate the nose and throat, cause chest constriction, and at high concentrations, produce severe coughing and the inability to concentrate.⁸¹

Carbon monoxide (CO) "...is a colorless, odorless, poisonous gas formed when carbon-containing fuel is not burned completely. It is by far the most plentiful air pollutant."⁸² Carbon monoxide does not remain long in the atmosphere (2-4 months), but it can reach dangerous levels in local areas. Carbon monoxide is an asphyxiate that binds with hemoglobin in the blood and displaces oxygen from the red blood cells. At relatively low levels of exposure (79 to 97 mg/m³ for one hour), CO decreases exercise tolerance for persons with coronary artery disease. In high concentrations, it is rapidly fatal.⁸³ "More than 75 percent of the CO emitted comes from road vehicles."⁸⁴

Nitrogen oxide (NO_x) and nitrogen dioxide (NO₂) are major air pollution indicators. Neither causes direct material damage; however, NO₂ reacts with moisture in the atmosphere to form nitric acid, which causes metallic corrosion and kills plants and fish. NO₂ can be an acute irritant. At concentrations found in the atmosphere, NO₂ is only potentially irritating and potentially related to chronic pulmonary fibrosis. Some increase in bronchitis in children (2-3 years old) has

been observed at concentrations below 0.01 parts per million.⁸⁵

VOCs are various types of hydrocarbons which are chemically reactive in the air near the ground and consist of such products as gasoline, solvents and paints, and by-products of burning gasoline, oil, coal, wood or trash.⁸⁶ Some VOCs are known carcinogens; others are major factors in the formation of smog.⁸⁷ The 1990 adjusted base year VOC emissions for the Washington Air Quality Attainment Area was 464 tons per day. Mobile sources, such as vehicles, produced 39 percent, or 179 tons per day, of the VOC emissions.⁸⁸ By 1996, the Washington Air Quality Attainment Area must reduce VOCs from the 1990 base year total by 15 percent, 24 percent by 1999, and maintain the reduced level thereafter. Projections are for uncontrolled VOCs to increase to 527 tons per day by 1996, requiring a net reduction of 133 tons per day to meet CAAA requirements.

C. Air Quality Model Results of VRE Operations

The VRE Ridership Survey of September 22, 1992 was not designed to provide data for air quality modeling; however, commuter mode-shift and related data from the VRE Ridership Survey allowed some preliminary calculations on air quality impacts resulting from VRE commuter use. *The calculations must be considered as*

very preliminary. More exact travel mode and distance data are needed before an air quality impact assessment can be made which accurately determines the VRE's impact on regional air quality. Data derived from the survey results included: miles traveled in POVs before using commuter rail, miles traveled to and from commuter stations and home, and reduction in miles traveled in POVs by use of VRE commuter rail. The University of Texas Center for Transportation Research converted the survey data into mode shift and VOC generation components for use in an air quality computer model. Computation of automotive emissions was accomplished using the US Environmental Protection Agency's MOBILE 4.1 model. VRE locomotive emissions were computed using equations published by the Research and Test Department of the Association of American Railroads. Data on hours of locomotive use, engine operating modes, trip mileage, etc. were provided by the VRE. Table 24 summarizes the model results.

Based on the survey derived calculations, the MOBILE 4.1 model calculations showed a net reduction in CO for the survey date of over nine tons (18,122 pounds), and a lesser, but still significant, net reduction in the controlling pollutant VOCs of 745 pounds (0.37 tons). Conversely, generation of NO_x increased by a net 1,208 pounds (0.6 tons) on that day. The latter was a not unexpected result of the NO_x producing propensity of diesel locomotives vis-a-vis gasoline fueled engines. It

should be noted that the NO_x emissions from the engines would remain static as ridership increased. The overall net reduction of the three combined pollutant sources for the day of the survey was calculated at nearly nine tons (17,660 pounds). The methodology employed to convert the VRE Ridership Survey data into model input data is presented in Appendix C.

Table 25

**Net Emission Changes by
Commuter Mode Shift from
POV to VRE Commuter Rail**

Mode Shift	Weighted Ridership (1993)	CO ₂ Emissions (1993) (pounds/day)	NITROGEN OXIDE (NO _x) (1993) (pounds/day)
Reduction from Prior POV Mode	(22,436)	(990)	(96)
Addition by VRE Commuter Rail	4314	245	1305
NET EMISSION CHANGE		(745) (tons/day)	1209) (tons/day)

Note: (---) indicates a reduction in emissions

Sources: Robert Harrison, University of Texas
Center for Transportation Research, and O.
Davis Brown, III, Transportation Consultant.