Characterization of On-Road Bus Emissions of NO_x, CO, and HCs

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Since the mid-2000's, management at the Cache Valley Transit District (CVTD) has solicited, funded and participated in studies examining the on-road emissions of CTVD's bus fleet. CTVD's motivation has been to assess their on-going contribution to the Valley's air pollutant emissions, and to evaluate how mass transit can lead to actual emission reductions by switching individual drivers into bus riders. In the fall of 2020, tailpipe emissions from three different CVTD buses were examined, in triplicate, driving the same transect: Route 5 which travels north from the Transit Center (150 E 500 N, Logan, UT) along Main Street (US Highway 91) to 2700 North and then returns to the Transit Center primarily along 200 East. During the transect, the buses go through highway and residential speeds and the roundtrip route is approximately 7.25 miles with a nominal drive time of 25 minutes. The three buses examined included an older (2008) diesel bus with 431,800 miles, a 2011 diesel/hybrid bus with 251,400 miles, and a newer (2019) diesel bus with 61,900 miles. On-road concentrations of oxides of nitrogen (NO_x), carbon monoxide (CO), hydrocarbons (HCs or VOCs), and carbon dioxide (CO_2) were monitored using an Applus 5-Gas Analyzer. Supporting measurements of exhaust system parameters (flowrate, temperature, pressure, vehicle speed, engine RPM) were also recorded using the bus's on-board diagnostic (OBD) systems. Although, not required by the project guidelines, tailpipe emissions of ammonia (NH_3) were also obtained by separate instrumentation (ECM mini-PEMS).

As may have been expected, the results showed the hybrid and newer buses emitted lower levels of the targeted pollutants than the older diesel bus. The older diesel bus had average emissions of 2.9, 0.49, and 0.91 g/mi for NO_x, CO, and HC, respectively. The hybrid bus showed comparative emissions of 1.8, 0.14, and 0.40 g/mi, respectively. Finally, the newer bus showed pollutant emissions of 0.03, 0.21, and 0.48 g/mi, respectively. For comparative purposes, a recent study of the representative Wasatch Front gasoline vehicle fleet found average NO_x, CO, and HC emissions of 0.12, 7.1, and 3.1 g/mi, respectively. Ammonia emissions from the older, hybrid, and newer buses were found to be 0.0021, 0.0002, and 0.0069 g/mi, respectively. Similarly, the gasoline fleet was found to have an average ammonia emission rate of 0.061 g/mi.