

November 23, 2014

California Air Resources Board
Katrina Sideco
(916) 323-1082
ksideco@arb.ca.gov

Reference: **EER for Heavy-Duty Buses**

Dear Ms. Sideco,

Life Cycle Associates would like to comment on the EER proposed for electric powered transit buses. Several aspects of the EER analysis were missing from the ARB staff's analysis and should be incorporated into the final use analysis of HDV EER.

- The EER comparison, coined in a CEC study (Unnasch 2000) is intended to compare like vehicles with comparable function. Such comparisons are often difficult because manufacturers do not offer identical vehicles for the purposes of developing EER comparisons (Unnasch 2007).
- The testing cited by ARB was for 40 ft buses, which appear to deliver comparable function for both the electric and diesel configurations.
- The buses were tested over the SAE type II test procedure. Prior tests of transit buses in California involved dynamometer testing over the CBD, ART, and COM cycles. These buses were also part of demonstration projects where on road fuel economy was recorded. The comparison between CBD tests and on road tests indicated that the driving cycle was a good proxy for transit bus fuel economy (Renner 1985, Unnasch 1993).
- Both of the electric buses cited in the ARB memo (ARB 1014) were configured with regenerative braking. Transit buses have several hundred horsepower of acceleration capability. This motor power also translates into regenerative braking. ARB should review what buses are equipped with regenerative braking as this is an important aspect of the high EER compared to conventionally fueled buses.

Best Regards,



Stefan Unnasch
Managing Director
Life Cycle Associates, LLC

References:

ARB (2014) Calculation of Proposed Energy Economy Ratio (EER) for Electric Buses Under the Low Carbon Fuel Standard Regulation.

Renner, R. A., Jackson, M. D., Unnasch, S., & Sullivan, C. (1985). Transit Bus Operation with Methanol Fuel (No. 850216). SAE Technical Paper.

Unnasch, S., Lowell, D., Lonyai, F., Dunlap, L., & Sullivan, C. (1993). Performance and emissions of clean fuels in transit buses with Cummins L10 engines (No. 931782). SAE Technical Paper.



Unnasch, S. & Browning, L. (2000). Fuel Cycle Energy Conversion Efficiency Analysis. California Energy Commission and Air Resources Board, Sacramento, CA.

Unnasch, S., M. Chan, L. Waterland, J. Pont (2007). Full Fuel Cycle Assessment: Tank to Wheels Emissions and Energy Consumption, California Energy Commission Report CEC-600-2007-003D.

