MODELING ON-ROAD PARTICLE NUMBER EMISSIONS FROM A HYBRID DIESEL-ELECTRIC BUS – AN EXPLORATORY ECONOMETRIC ANALYSIS

A Thesis

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ABSTRACT

The purpose of this econometric analysis is to model the concentration of particle number emissions from a hybrid diesel-electric bus in terms of operating characteristics. Important aspects of this study are that particle number concentrations are modeled instead of particle mass, and the emissions are recorded using on-board instrumentation in real-world driving conditions. The operating characteristics included in the final models are two engine parameters: fuel rate and engine speed and two vehicle parameters: velocity and acceleration. The emissions data possess properties that frequently cause problems in regression analysis: nonstationarity, multicollinearity, heteroscedasticity, and autocorrelation. Methods for overcoming and/or minimizing the effects of these properties are implemented. The Newey-West autocorrelation consistent covariance estimator is implemented using ordinary least squares (OLS) to produce a model that accounts for heteroscedasticity and autocorrelation, without requiring assumptions to be made about the structure of the model disturbances. A first-order autoregressive process is used with feasible generalized least squares as a comparative model. Both models have similar coefficients, fit and predictive capability. However the models are specific in scope to typical freeway driving conditions. In future studies, the researchers anticipate applying econometric analysis to model particle number emissions among different routes, bus technologies, aftertreatments, and atmospheric conditions.

BIOGRAPHICAL SKETCH

Darrell Sonntag received his B.S. degree in Civil Engineering from Brigham Young University in 2005. He is beginning his third year of MS/PhD studies at Cornell University, where he has been researching vehicle emission modeling. So far his research has been focused on particle number emissions, and EPA's new emission model, MOVES. He has presented on both topics at transportation conferences, NATMEC (2006) and TRB (2007). Darrell is currently a Dwight David Eisenhower Transportation Fellowship Recipient. He and his wife, Amy, currently reside in Ithaca, New York.

To Amy

for

“helping me to make

Of the lumber of my life

Not a tavern

But a temple;

Out of the works

Of my every day

Not a reproach

But a song.”

(*Love* by Roy Croft)

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES