Why do truckers idle?

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Abstract Many of the 458,000 line-haul trucks (Heavy Class 7 and 8 of more than 26,000 lbs.) in the United States idle up to 40 % of engine run time on average, and this consumes approximately 875 million gallons of diesel fuels yearly. Consequently, idling imposes a high operating cost to trucking companies while simultaneously entailing a high cost to society in terms of health, environment, and national security. Although many studies have proven truck idling alternatives, such as truck stop electrification and auxiliary power units, to be cost effective, a large proportion of truckers are not motivated to adopt them. Despite the plethora of benefits gained in adopting an idling alternative, there remain barriers to implementation. In order to address national idling inefficiencies and develop effective approaches to encourage truckers to idle responsibly, it is necessary to understand truckers' attitudes and behaviors and their effects on idling practices. Truckers' attitudinal and demographic data collected by the UC Davis idling research team is analyzed to understand behavioral variables that affect idling practices. Contrary to past studies that stated that environmental attitudes affect behavior, truckers who identify pro-environmental attitudes do not exhibit higher idling hours than truckers who do not exhibit pro-environmental attitudes. Idling practice is independent of environmental concern. Truckers' idling behavior was related to the amount of training they received on reduced idling. These results suggest that training for all truckers is necessary to reduce idling.

Introduction

Heavy duty truck idling imposes a high operating cost to trucking companies while simultaneously entailing a high cost to society in terms of health and the environment. Many of the 458,000 line-haul trucks (trucks that fall under Heavy Class 7 and 8 of more than 26,000 lbs.) in the United States travel for more than 500 miles from home-base each day and idle between 3.3 and 16.5 hours per day, which accounts for up to 40 % of engine run time depending on the season and operation (Stodolsky et al. 2000). Idling consumes approximately 2.5 % of the total 35 billion gallons of diesel fuels consumed annually in the United States (Jackson et al. 2003, Stodolsky et al. 2001) and idling accelerates the wear and tear of the engine (Stodolsky et al. 2000), which increases maintenance cost.

Idling emits 11 million tons of carbon dioxide, 180 thousand tons of oxides of nitrogen (mostly nitrous oxide and nitrogen dioxide) and 5 thousand tons of particulate matter annually. Carbon dioxide and nitrous oxides are greenhouse gases that contribute to the increase in global warming. Particulate matter and nitrogen dioxide contribute to the smog in the air, which is detrimental to human health. There is an escalation of public health concerns that lead to high health care cost due to higher prevalence in asthma, cardiovascular disease, cancers, eye impairment, and noise pollution (Polosa et al. 2002). Health concerns especially become more serious when trucks idle in communities that are already disproportionately impacted by air pollution, such as areas that inhabited by poor, low-minority populations (CA ARB 2003).

Idling is common practice for heavy duty trucks in operation in the US for one or more of the following reasons: to power climate control (e.g. heaters and air conditioners) and sleeper compartment electrical appliances (e.g. refrigerators, microwave ovens, and televisions); to prevent start-up problems in cold weather; to drown out noise; and to maintain brake system air pressure (Broderick et. al 2003). Also truckers have cited that they idle their engines for reasons of safety (e.g. to provide cooling or heating when windows are closed), and habit (U.S. EPA 2002). Overall, idling provides truckers comfort, security, and convenience on the road.

Although government and industry tend to be at odds on many environmental issues, both groups agree that idling alternatives need to be implemented because the effects of idling is disadvantageous and undesirable (Lutsey et. al 2003). The trucking industry wants to reduce idling to save fuel consumption and reduce engine maintenance, and local and state agencies have enacted idling restrictions and bans to reduce emissions (Levinson 2001, Texas

Administrative Code 2001). In May 2001, the Bush administration issued the National Energy Policy that instructed the Environmental Protection Agency (EPA) and Department of Transportation (DOT) to collaborate with trucking industries to develop a plan to reduce emissions and fuel consumption from heavy duty trucks (U.S. EPA 2002). The dire need to reduce emissions and fuel consumption prompted many agencies; such as the Institute of Transportation Studies of University of California at Davis, U.S. EPA, California Air and Resource Board (CA ARB 2003), and the Argonne National Laboratory to propose promising alternatives to idling. Such alternatives consist of the direct-fired heater, fuel cell auxiliary power unit (APU), thermal storage, direct heat with storage cooling, and truck stop electrification (Stodolsky et. al. 2001). Each of these alternatives falls into either of the two categories: grid-connection ("shore power") and on-board auxiliary (APUs), and they are both being pursued by industry and the government (Lutsey et al. 2003).

While cooperative industry-government working groups are collaborating to address idling problems and despite the many studies that have emphatically proven that idling alternatives are cost effective and beneficial from a health and environmental stand point, a large portion of truck drivers are not motivated to adopt the technologies (Broderick 2004, pers. comm.). The Argonne National Laboratory and the Institute of Transportation Studies of University of California at Davis have examined truckers' habits and their understanding of idling (Broderick 2004, pers. comm.), but hardly any studies have delved into understanding why truckers are reluctant to adopt alternatives. Previous studies have suggested that adoption of pro-environmental behavior is influenced by convenience, comfort, and safety (Cottrell 2003, Blake 2001). It follows that truckers attitudes affect the adoption of idling alternatives, and it has been suggested that truckers who view their convenience, comfort, and safety as taking precedence over saving fuel and cleaner air would not be likely to adopt idling alternatives (Spivey 2004, pers. comm.).

In order to develop effective policies and approaches to help overcome truckers' reluctance to adopt idling alternatives, outreach and policy makers need to better understand drivers' attitudes and how these relate to truckers' behaviors. Before attempting to understand why truckers are reluctant to adopt alternatives, policy needs to understand why truckers idle excessively in the first place, which is the root of the problem. Truckers who idle less or learn to idle less may be a precursor for truckers to adopt alternatives. Truckers who idle excessively

may not adopt idling alternatives despite the many benefits that result from them. The purpose of this study is to offer better insight for industry and government so they can develop efficient policies and effectively reach out to their targeted audiences. Following on the studies of Blake (2001) and Cottrell (2003) that related environmental attitudes and behavior to socio-demographic variables, I hypothesize that truckers who identify environmental attitudes will idle significantly less and be more likely to adopt alternatives than truckers who do not identify environmental attitudes.

In mid January 2003, Christine-Joy Broderick, the head researcher of the national idling project from University of California at Davis (UC Davis), and her colleagues and graduate students conducted a survey across the US to quantify truckers behavioral and attitudinal variables (Lutsey et al. 2003). This paper takes a first step at analyzing the data to determine what factors (e.g. demographics, social economic, education, etc.) affect environmental attitude and idling reduction actions, whether truckers are concerned of the effects of idling, how drivers' environmental attitudes and idle reduction actions are linked, and if there are trends in actions/attitudes based on truck ownership status (Broderick 2004, pers. comm.).

Methods

To test the hypothesis, a survey conducted by the group at UC Davis was used to quantify the behavioral and attitudinal variables. There were 5 parts to the survey: vehicle characteristics (Part A), typical vehicle use (Part B), opinions about truck technologies and driver habit, interest in potential technologies (Part D), and demographics (Part E) (Lutsey et al. 2003). Twelve questions that addressed truckers behavior (questions # 2, 5, 6, 7, 10, 11, 12, 13, 14, 18, 19, 21) from Part C were chosen based on their significant effect on idle duration and environmental score. These questions asked for truckers' views on resource depletion, fuel cell technology, diesel pollution due to idling, national air quality, national fuel consumption, idling alternatives, government incentives to reduce idling, national oil dependency, environmental problems, and global warming. The responses ranged from 1 to 5, with 1 having the lowest and 5 having the highest respect for and knowledge about the environment.

Using JMP-IN software (SAS Institute Inc.), Analysis of Variance (ANOVA) was used to analyze the data. The independent variables in the ANOVA were variables from Part A, B, D, and E. The dependent variables were average idle duration and the environmental score (Part C).

The environmental score was used in 2 ways: (1) as the score for each of the 12 individual questions; (2) and as an aggregate sum of all 12 questions. Differences among groups were considered to be statistically significant when $p \leq 0.05$.

Results

From Part A of the Lutsey et al. survey on truckers' vehicle characteristics, the tractor's make or model and type of trailer did not significantly affect truckers' idling hours or environmental scores. The type of ownership (you, your company, or leasing company) and the number of tractors owned or operated by truckers themselves or by truckers' companies did not significantly affect idling hours or the environmental scores (Table 1).

Table 1. Factors influencing idling hours and environmental scores. Significant (S) vs. non significant (NS) results and positive (+) vs. negative (-) effect of the independent variable.

Independent Variable ' X'	**Idle Hours**	**Environmental Score**
In control of purchase of retrofit	S+	NS
Method to reduce idling: Training on decrease idling	S+	NS
Attend educational session at truck shows	S+	NS
Stop at certain truck stop determined by fleet	NS	S+
Stop at undesignated stops and in prohibited areas	NS	S-
Seen idling alternatives in government material, magazines, ads	NS	S+
Have considered buying device	NS	S+
Demographics: Age, gender, year of profession, education, income	NS	NS
Zip Code of home address	NS	NS

From Part B of the survey on trucker's typical vehicle usage, only training on decreased idling played a significant and positive role in the methods used by truckers to reduce idling. Financial incentives, automatic engine shut-off and startup, and punishment were not statistically significant as methods that aided in reducing idling. Truckers who attended truck trade shows and saw idling alternatives at shows had significantly higher environmental scores, but this factor had no significant effect on idling hours. However, truckers who attended educational sessions at truck trade shows had significantly lower idling hours, but this did not have a significant effect on environmental scores. Truckers who chose to stop in certain truck stops determined by fleet had significantly higher environmental scores while truckers who chose to stop at undesignated and prohibited stops had significantly lower environmental scores. However, the places where truckers chose to stop did not significantly affect their idling hours. Truckers who were exposed to government material or magazine articles and advertisements on the effects of idling and their

alternatives had significantly higher environmental scores, but this exposure did not have a significant effect on idling hours.

From Part D on truckers' interest in potential technologies, truckers who had control of purchase of retrofit devices for tractor-trailer had significantly lower idling hours than truckers who had no control over retrofit. Truckers who considered buying a device that would reduce main engine idling had significantly higher environmental scores, but this higher environmental score did not show any significant effect on idling hours.

From Part E of survey on truckers' demographics; such as age, gender, years of professional experience as drivers, level of education (some high school, high school, some college, college degree, graduate degree), and annual income did not significantly affect their idling hours nor did they affect their environmental scores. Trucker's state of residence did not significantly affect the idling hours or environmental scores.

Discussion

Truckers who have statistically significant high environmental scores do not necessarily have low idling hours. Truckers who have attended truck shows that present idling effects and alternatives, read or seen idling advertisements, stopped responsibly at certain truck stops determined by fleet, and have considered alternative adoption do demonstrate that they are environmentally concern due to their high environmental scores. However, their concerns for the environment do not positively affect their idling hours. Despite truckers heighten pro-environmental attitudes following information disclosure from shows and advertisements, the effects on their idling hours are statistically insignificant.

Truckers who have the authority to purchase an idling alternative have lower idling hours than truckers who do not have the authority to purchase. Truckers who have the authority to purchase alternatives are likely to be the owners of their tractors; therefore, they are more reluctant to idle excessively because they would have to internalize the cost of excess fuel usage due. Also, truckers who attend educational sessions on reduced idling were likely to take what they learn into practice since they were more aware of the benefits of reduced idling; such as cost savings and health reasons, despite their low environmental scores. These findings show that truckers who have pro-environmental attitudes do not guarantee truckers' reduction in idling hours. According to the data, the variables that significantly affect environmental scores do not show significant effects on idling hours. On the contrary, the variables that resulted in lower

idling hours are not coupled with higher environmental scores. According to data, some truckers who idled less have lower environmental scores than truckers who idled more. In addition, the location to where a trucker resides does not significantly affect the idling hours or the environmental scores.

In addition, trucker's age, gender, years of professional experience, income, and level of education do not affect their idling hours or environmental scores. Truckers who are younger, have less experience, and have received lower levels education do not necessarily have higher idling hours or have lower environmental awareness than truckers who are older, have more experience, and have received higher levels of education.

Contrary to the studies by Blake (2001) and Cottrell (2003) which stated that environmental attitudes affect people's behaviors, truckers who identify environmental attitudes do not exhibit lower idling hours than truckers who do not identify environmental attitudes. Instead, truckers who attend educational sessions on reduced idling are more likely to idle less and be more likely to support the adoption of idling alternatives. In order to effectively reduce idling among the trucking population, more emphasis on training and education should be used to target all truckers; regardless of their demographics, type of ownership, or environmental attitudes. Training and education should focus on breaking truckers ingrained habit to idle and make them aware of the economic, health, and driver enhancement benefits from reduced idling. In addition to targeting behavior change in the overall trucking population, educational seminars and incentives should specifically target truck owners because they are the sole deciders on technology purchases and are responsible for providing educational sessions and training to their truckers.

Moreover, more research on successful fleet applications is needed in order to identify key factors for achievement and to determine their motivation and results. Identification of successful fleet applications can increase interests of potential consumers and make strong business case for fleet adoption of alternatives. The government, grass root organizations, and the public community can also aid to push idle reduction technologies toward broad market appeal.

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