A Low-Cost Option for Real-Time Fuel Economy Data

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Following in Lee Schipper's Footsteps

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Need for Accurate In-Use FE Data

- Statistically valid in-use fuel economy data has not been gathered in almost 20 years
- EPA 2008 FE label value adjustments were built on quicksand
  - Piled assumption upon assumption, with no underlying in-use fuel consumption data
- Off-cycle credits in 2017-25 CAFE/CO2 standards
  - Based upon in-use benefits – errors will affect standard stringency
- VMT (VKT) estimates are usually based on fuel use and estimated fleet average fuel economy
- Worldwide data on in-use FE is similarly lacking

Factors Affecting In-Use Fuel Economy

- **Cold temperatures**
- **Trip length**
- **Driving Behavior – speed, aggressiveness, idling, etc.**
- Air Conditioning usage
- Cargo and passenger weight and trailer towing
- Road type and speed limit
- Roof racks
- Wind, rain, and snow
- Altitude
- Poor maintenance
- Aftermarket tires
- Tire wear (rolling resistance goes down as tire wears)
- Ethanol blends (E10 has 3% lower energy content than gasoline)
- New vehicle effect (FE improves as vehicle breaks in)

Data Collection Objectives

- Determine impacts of driving behavior and ambient and road factors on in-use fuel economy.
- Compare in-use FE to FE test results and label values across vehicle models
  - Requires consistent method for each model to avoid biases in relationship of in-use FE to FE label value
- Accurate data on vehicle driving patterns

In-Use Data Needed

- Need FE data AND activity data (e.g., temperature, speed, acceleration, location)
- Data collection year around
- Driving conditions across the nation
- Cover range of temperature, air conditioning operation, and road types
- Cover range of driving behaviors
- Cover range of vehicle models across manufacturers

Program Design

- Dataloggers need to be installed on customer vehicles
  - This is the only way to gather accurate in-use data
- Data should be collected on each vehicle for one year
  - Accurately captures seasonal effects (both temperature and trip behavior) while avoiding problems with statistical sampling
  - Can store data onboard and process after removal, or can download the data wirelessly as the project is going on
  - Short-term data sampling is statistically problematic
- Participants should be selected randomly, nationwide

Dataloggers

- Most data available from OBD system:
  - Fuel consumed (second-by-second)
  - Vehicle speed (second-by-second)
  - Ambient temperature
  - Engine temperature
  - Time of each trip start and end
- Datalogger should include an internal GPS to record position
  - Allows post-processing for road type and altitude
- OBD dataloggers are readily available and are available with GPS

Lessons from SFTP Project (1993)

- Determined about 100 vehicles from each city would adequately cover the range of in-use drivers and vehicles
  - For fuel economy, also need to consider geographic distribution
  - On the other hand, the SFTP project was designed to assess emissions impacts. Emissions are non-linear at high loads, so it was important to sample enough drivers and vehicles to gather valid data on extreme driving behavior. Fuel consumption is far more linear and, thus, fewer drivers are needed.
- Participants should be selected at random from a comprehensive list of vehicle owners.
  - To ensure that there is no bias in types of vehicles or owners who refuse to participate, owners who refuse to participate should be replaced with another owner with the same demographics and vehicle type

(Crude) Estimate of Program Costs

- Datalogger: ~$500 to $1000 each
- Customer incentive: ~$500 to $1000 per vehicle
- Contractor cost: ~$1000 per vehicle
  - Recruit vehicle owners, install dataloggers, retrieve data
- Total cost ~$2,000-$3,000/vehicle (not including data analysis)

# vehicles	Cost @ $2,000/veh	Cost @ $3,000/veh
100	$200,000	$300,000
200	$400,000	$600,000
400	$800,000	$1,200,000

Conclusions

- Extensive vehicle use and fuel consumption data could be gathered via OBD dataloggers for perhaps as little as $200k per country
- This information could be mined for both vehicle and transit data
  - More accurate fuel economy labels
  - Better VMT (VKT) estimates
  - Better estimates of savings from efficiency and CO2 standards
  - Better decisions on road and transit projects
  - Comparison of driving and fuel consumption across countries

Thank You

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