

Improving Evaluation of Mobile Source Policies

Presentation to the NRC Committee
Reviewing the MOBILE Model

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IMRC Role

- Evaluate Smog Check program
- Recommend program improvements to Legislature and Governor

Two Propositions

- MOBILE ill equipped to explain vehicle emissions or to predict the effects of new policies
- Goal of NRC evaluation should be better mobile source policy outcomes and evaluation, and not a better model *per se*

Modify Project Scope

- Is MOBILE a valid tool to evaluate or determine mobile source policies?
- How can mobile source policy development and evaluation be improved?

Concerns With MOBILE

- Unrepresentative input data
- Unsound data analysis techniques
- Structural limitations
- Validation problems

Unrepresentative Input Data

- Recruitment biases
 - Unrepresentative mix of vehicles
 - Unrepresentative on day of recruitment
- Small samples
- Artificial studies

Recruitment Bias

- Vehicles different on day of test
 - Set-up car to pass test
 - AZ, MN, CA
- Low response rates in mail solicitations
 - Non-respondents likely have higher emissions
- Don't see unregistered vehicles
 - I/M, insurance requirements, fees, etc.

Small Samples

- MOBILE5 databases
 - IM240 ID Rates: 274 vehicles
 - Repair Effectiveness: 266 vehicles
- Both datasets divided into technology/emitter sub-groups, some with very few vehicles

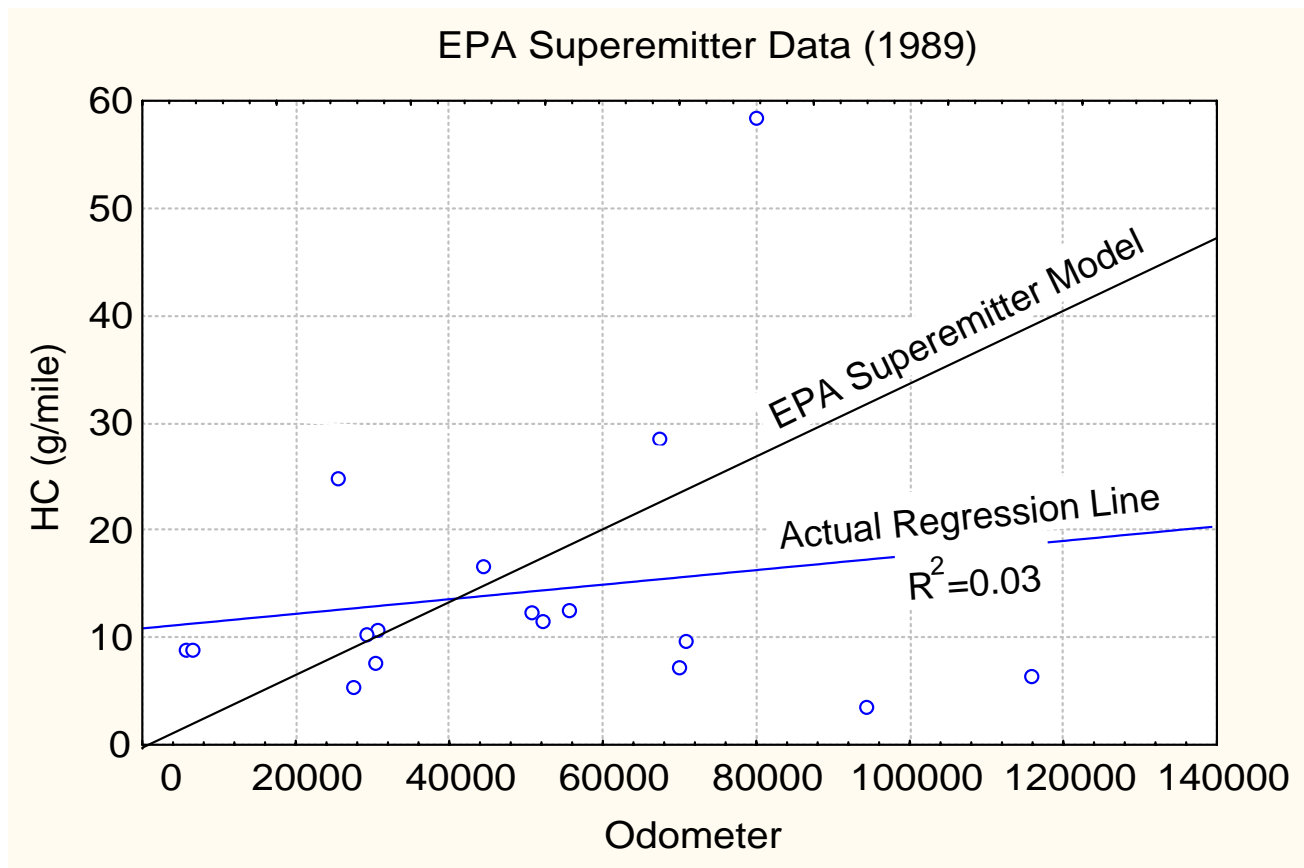
Artificial Studies

- Repair effectiveness based on results with EPA-paid contractors, rather than real-world mechanics and real-world motorist-mechanic interaction.

Unsound Data Analysis

- 46% of repaired vehicles did not meet standard
 - Emissions values artificially adjusted downward
- Super-emitter model
 - Data on 17 vehicles
 - R^2 of zero, but EPA drew arbitrary line through origin and centroid

EPA Super-Emitter Model



Conclusions on Input Data

- Some MOBILE inputs not tied in any legitimate way to measured values
- Measured values likely not representative of real-world vehicles

Structural Limitations

- Human behavior not modeled
- Static rather than dynamic and stochastic
- Ad hoc relationships among variables
- Unrealistic assumptions

Human Behavior Not Modeled

- All behavioral effects subsumed in *ad hoc* factors added after emission calculations
- $BER_{I/M} = B_o(1 - (\text{CRED} (1-w) f(c) d))$
 - $d = \text{discount}$; $f(c) = \text{compliance rate}$
- Static factors can't encompass dynamic responses to wide range of variables
- Fudge factors subvert any presumed accuracy of basic emission rate calculations

Motorists and Mechanics Respond to Many Factors

- Program incentives
 - enforcement
 - on-road testing
 - repair costs
- Economic conditions
- Other policies
 - registration fees
 - auto insurance requirements

Unrealistic assumptions

- Only one chance to fail a high emitter
 - Overemphasizes test ID rate
- I/M emission reductions persist forever
 - Overestimates repair effectiveness

MOBILE Is Not a Model

- No representation of the interactions among the social and physical processes that affect emissions
- *Ad hoc* combination of emissions data, hardwired input assumptions, and arithmetic operations
- Not capable of evaluating policies
 - Many real-world factors could change without affecting output of MOBILE

Model Validation

- Poor record in predicting emissions
- Unlikely to predict for the right reasons
 - Many free parameters
 - Input data time/place specific
 - Structural problems
 - Key real-world effects not modeled

MOBILE Used for High-Stakes Decisions

- Policies that don't receive credit won't be considered
- I/M can crowd out other effective policies

MOBILE6 Does Not Correct Structural Problems

- Better input data
- New “technical” features
- But fundamental problems remain:
 - Static structure
 - No explicit treatment of human behavior
 - Ad hoc relationships among variables

Focus on Achieving Better Policy Outcomes

- Project Scope focused on improving model
 - Human behavior and dynamic effects not explicitly addressed
- Goal is not better model *per se* but better selection and evaluation of mobile source policies

Key Questions

- Is MOBILE a valid representation of the processes that affect real-world vehicle emissions?
- Is use of MOBILE justified for evaluating mobile source policy or determining effects of policy changes?
- What are optimal data collection strategies for determining real-world effects of policies?

Potential Recommendations

- Draw conclusions about the model
 - Improve, supplement, or replace
- Urge real-world validation of all major policies
- Detailed model validation to ensure predictions result for correct underlying reasons