Addressing Greenhouse Gas Emissions from Light-Duty Vehicles

University of Michigan Focus on the Future Automotive Research Conference

US EPA
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Briefing Overview

- Background on EPA’s National Vehicle and Fuel Emissions Laboratory

- Building Blocks for EPA Light-duty GHG Analysis
  - Technology Effectiveness
  - Technology Costs
  - EPA GHG Model

- President’s Announcement of a National Program and upcoming EPA & NHTSA Joint Rulemaking
EPA’s National Vehicle and Fuel Emissions Laboratory

- The Office of Transportation and Air Quality (OTAQ) is divided between EPA's headquarters in Washington, D.C., and the National Vehicle and Fuel Emissions Lab in Ann Arbor, Michigan.

- The NVFEL is a world-class state of the art testing & research facility.
U.S. Vehicle Criteria Emissions History

- U.S. was regulatory pioneer in 1970s
  - Major experiment as U.S. “went it alone”
  - In Clean Air Act, Congress gave EPA “technology forcing” powers and California ability to set its own standards
  - Many feared economic risk and industry collapse

- EPA’s principles
  - Identify feasible and cost-effective technology
  - Set performance standards to drive innovation and allow flexible compliance
  - Allow lead time for normal business investment cycles
  - Comprehensive approach with all subsectors and fuels
  - Open process with broad stakeholder involvement
U.S. Vehicle Criteria Emissions Success Story

- World’s cleanest and best vehicles
  - New cars are 98% cleaner (similar reductions for heavy-duty, nonroad, etc.)
  - OMB agrees that public health benefits far exceed the costs, often by 10:1 or more
  - Technology innovation also promoted better vehicle quality, reliability, and durability

- Lower ambient pollution levels despite near tripling of U.S. GDP since 1970

- EPA and California’s approach are the model for the rest of the world
OTAQ is a Regulatory Leader with Deep Depth of Technical Experience

- OTAQ has a long history of designing regulations based on the state-of-the art science and engineering analysis
  - Recognized as the experts in the design and implementation of emission standards, test cycles, procedures and measurement tools for CO2 emissions (fuel economy) and other mobile source GHGs
  - Fully understand the “real world” aspect (beyond lab tests) of emissions and fuel economy as successfully demonstrated in the 2006 vehicle fuel economy labeling final rule

- In light duty vehicle expertise alone we have:
  - 50+ engineers and scientists with extensive experience with the automotive industry
  - Utilized EPA laboratory and have managed many contracts to pull in even further expertise on technology feasibility, costs and effectiveness
EPA Fuel Economy Program

- EPA has responsibility for:
  - All vehicle fuel economy testing and federal database
    - Test procedure development
    - Testing at NVFEL and oversight of testing at automaker labs
  - Consumer fuel economy information
    - New vehicle window stickers
    - Fuel Economy Guide (w/DOE)
    - fueleconomy.gov (w/DOE) and epa.gov/greenvehicles
  - Providing automaker CAFE compliance values (to NHTSA)
  - Identifying Gas Guzzler Tax cars (to Treasury)

- EPA publishes annual Fuel Economy Trends report
Adjusted Fuel Economy, 1975-2008

Adjusted Fuel Economy by Model Year
(Annual Data)

Adjusted MPG


Model Year

Cars
Trucks
Both

Light-Duty Automotive Technology and Fuel Economy Trends:
1975 Through 2008

Executive Summary
Recent and On-going EPA Technical Assessment to Support Light-duty GHG Standards
Building Blocks for EPA Light-duty GHG Analysis

- EPA has undertaken substantial technical work to analyze light-duty GHG standards
  - 2008 EPA report on technology costs and effectiveness
  - 2008 CO2 vehicle simulation modeling report from EPA & Ricardo
  - 2009 EPA report on auto industry indirect costs
  - Major new 2009 technology cost study underway
  - New EPA GHG technology and cost model
Technology Effectiveness

- 2008 Vehicle Simulation Modeling Study from Ricardo
  - EPA engineers worked with international automotive engineering consulting firm on ~$1 million peer-reviewed technology effectiveness study

  - EPA staff assessment of existing literature on CO2 technology costs and effectiveness
Two major cost categories for an automotive manufacturer

- **Direct Manufacturing Costs**
  - Costs for producing a component or a vehicle
    - Labor, raw materials, utilities for production plant

- **Indirect Manufacturing Costs**
  - All other costs for running an auto firm
    - Research, capital investments, product development, warranty, corporate overhead, pensions, retiree health care, dealership support, etc.
Robust Cost Estimates Are Critical

- New EPA Analysis -- a transparent, high-quality analysis done “from the ground up”

- Contracted to **FEV Engine Technologies** – a limited number of firms are capable of doing this work
  - A widely respected, independent, engine and powertrain advanced R&D company

- FEV has also engaged **Munro & Associates**: experts in “lean design & lean manufacturing”

- **EPA review team** consists of >10 engineers/specialists
How To Do Ground-Up Costing: Side-by-Side Teardowns

Downsized turbocharged direct-injection engine

Conventional engine
How To Do
Ground-Up Costing: Side-by-Side Teardowns

results are tallied up in (very large) spreadsheets

parts are then compared—new materials? size? machining steps? completely new or eliminated components?

Cost factors are applied: labor and overhead rates, raw material prices, energy use, design optimization (forecast to full-production model year)
Costing Both Nearer-Term and Longer-Term Technologies

Among the technologies to be included in the study:
- Downsized turbocharged gasoline direct-injection (GDI) engines
- Hybrid electric vehicles
- Advanced transmissions (6-speed, dual clutch)
- High-efficiency, low-leak air conditioning
- Advanced diesel engines
- Plug-in hybrids
- Full electric vehicles
- Homogenous charge compression ignition engines
- Lean-burn GDI engines
New EPA Indirect Cost Study
Methodology

- New report published in Feb 2009 with RTI International and UMTRI (Dr. McManus)

- Updates and replaces previous EPA assessments of indirect cost multipliers for automotive industry

- Replaces the concept of “Retail Price Equivalent” Factors with more tailored indirect cost multipliers, which vary by:
  - Degree of complexity for new component/technology
  - Time frame of technology introduction (e.g., near-term versus long-term)
EPA GHG Light-duty Vehicle Model

- In 2008-2009 EPA developed a new computer model capable of analyzing vehicle GHG standards which can be promulgated under Section 202 of the Clean Air Act
  - The model can analyze standard approaches and flexibilities allowed for under the CAA.

- The model includes treatment of the following key factors;
  - Multi-year planning by auto firms;
  - Emissions averaging; and emissions trading between cars and trucks in the same firm;
  - Treatment of all automotive GHGs, including air-conditioning impacts.

- Model Approach
  - Determine the cost of lowering GHG emissions of light-duty vehicles
  - Adds available technology to a baseline fleet in a cost effective manner
  - Estimates a wide variety of economic, environmental and social impacts associated with GHG controls
    - Annual fuel savings and social cost of carbon (or GHG benefits)
    - Criteria emissions, noise, congestion, accidents, refueling time, etc.

- Model is undergoing peer review, and will be released to the public in the near future
President’s Announcement of a National Program and upcoming EPA & NHTSA Joint Rulemaking
President Obama’s May Announcement

- President announced a historic program for reducing future automotive GHGs and improving fuel economy
  - A coordinated Federal program for new GHG and fuel economy standard for 2012-2016
  - Would achieve a fleet wide level of 250 grams/mile CO2 in 2016 [35.5 mpg]

- Will occur under a joint regulatory action promulgated by NHTSA and EPA

- On the same day;
  - California Governor, Attorney General, and Chairman of the Air Resources Board announced their support for the National Program
  - 10 major automotive firms announced their support for the National Program
Upcoming EPA and NHTSA Regulatory Action

- EPA and NHTSA will undertake a joint rulemaking
  - On same day as President’s announcement - EPA Administrator Jackson and DOT Secretary LaHood signed a Notice of Intent to conduct a joint rulemaking

- Notice of Intent discusses;
  - Principles and Key Elements of the National Program
    - Levels of the standards
    - Form of the standards
    - Program flexibilities
    - Compliance elements
Notice of Intent: level of the standards

- EPA considering 2016 standards which would lead to the new vehicle fleet achieving 250 grams/mile CO2
  - Based on application of available technologies
    - e.g., adv. transmissions, GDI, turbo-downsizing, aero improvements, weight reduction, cylinder deac. systems, etc.
    - Also allows for reductions in HFC and CO2 from air conditioning systems
  - Stds. will begin in model year 2012 and phase-in to 2016 in a generally linear approach

- NHTSA to propose appropriate related CAFE standards
Notice of Intent: form of the standards

- EPA and NHTSA intend to propose attribute-based standards using vehicle footprint
  - Same approach used in recent NHTSA CAFE rules

- EPA and NHTSA intend to propose separate standards for cars and trucks

- Attribute approach allows different standards for different manufacturers based on the make-up of their fleet
  - E.g., smaller footprint vehicles must achieve lower CO2 targets than larger footprint vehicles
Notice of Intent: program flexibilities

- EPA intends to propose
  - Flexible CO2 credit system
    - E.g., credit banking, unlimited credit trading between cars and trucks, credit trading with other auto firms, carry forward and carry-back of credits
  - Option to apply air conditioning controls to generate credits for showing compliance with standard
    - Manufacturers can generate credits through reduction in HFC leakage or alternative refrigerants, and by improving A/C system efficiency
  - Allowance for flex-fueled vehicle credits (E85 vehicles) for 2012-2015 consistent with CAFE
  - Temporary lead-time allowance alternative standards
    - An optional higher standard for a portion of small and medium volume firms fleets for 2012-2015
  - Additional credit generation opportunities
    - Early credit generation for 2009-2011, additional credits for advanced technology vehicles, and credit generation opportunity for technologies not reflected in EPA/CAFE test procedure
Notice of Intent: compliance elements

- EPA and NHTSA intend to propose compliance programs which replicates as closely as possible the existing NHTSA CAFE and EPA Tier 2 compliance programs
  - Minimize additional compliance testing burden and make use of current approaches
  - E.g., make use of existing CAFE testing data to show compliance with EPA CO2 standard
National Program for 2012-2016

- Next steps
  - EPA and NHTSA intend to issue the joint proposal by the end of August 2009
  - Final regulatory action planned for no later than March 31, 2010