Heavy-Duty Vehicles

Regulatory opportunities, design challenges and policy-relevant research

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Topics

- Regulatory update by country
- Technology potential
- GHG/FE standard design
  - Regulated entities
  - Metrics
  - Test Procedures
Regulatory Update: Japan

- Adopted in 2005 for model year 2015
- Top runner approach
  - ~12% average improvement over 2002
- Compliance testing combines engine testing and simulation modeling
  - Standard values used for many parameters (e.g. aerodynamic drag, rolling resistance)
- Delay in post-2009 NOx “challenge goal” adoption
Regulatory Update: US

- **Energy Independence and Security Act 2007**
  - US DOT to develop fuel economy standards for trucks 8,500 lbs GVWR and above
  - Effective model year 2016 at the earliest (4 years lead time, 3 years stability)
  - NAS panel to determine technology potential

- **US EPA GHG rulemaking process**
  - HDV options in Advance Notice of Proposed Rulemaking in 2008
  - GHG proposal likely in 2010
Regulatory Update: California

- Trucks operating in CA pulling 53+ ft trailers
- Tractors
  - Lower rolling resistance (LRR) tires for all existing tractors (some exceptions)
  - MY 2011+ sleeper tractors must be SmartWay certified
  - MY 2011+ day cab tractors must have LRR tires
- Trailers
  - MY 2011 must be SmartWay certified or retrofitted with SmartWay verified technologies
  - Existing trailers meet same standards by end of 2012 with some options
- Expect 750 million gallons diesel saved by 2020
Euro VI text instructs the commission to:

- “Study the feasibility and the development of a definition and methodology of energy consumption and CO2 emissions for whole vehicles and not only for engines”

Commission request for proposal on test procedures

- ACEA& EUCAR proposal to evaluate fuel efficiency using computer simulation
  - Pre-study in 2009
  - Multi-year project
Regulatory Update: China

- Central government’s goal is to reduce fuel consumption from all modes
- Homegrown industry
  - 400 HDV manufacturers (15,000 vehicle types)
- China Automotive Technology & Research Center (CATARC) lead agency for LDV and HDV fuel consumption standards development:
  - Develop test procedures by end 2009
    - Considering adapting Japanese program
  - Standard limits and program design to be established in 2010
Market is not driving efficiency gains

- Conventional wisdom
  - Fuel savings affect fleet bottom line, cost effective technologies will get adopted

- Reality check
  - US new vehicles <1%/year improvement fleet-wide in last 15 years
  - Low market share for cost-effective retrofits (e.g. aerodynamic and rolling resistance)
  - Lack of standardized and reliable information on efficiency technologies
  - Other priorities (e.g. driver retention, maintenance, down time)
Technology Potential: ICCT-NESCCAF Study

- Partnership with NESCCAF (Northeast States Clean Air Future)
- Evaluate - through simulation modeling - the combination technologies resulting in the greatest real-world emissions and fuel consumption improvements
- Focus on Class 8 trucks in long haul applications in the United States
  - Technology scenarios for 2012 and 2017
- Estimate resulting cost savings
Technology Potential - NESCCAF/ICCT

Building Block Technologies

Reductions with respect to Package #3

Operational Measures

Maximum Reduction Combinations

(1) RMD - 45-48 foot trailer coupled with a 28 foot trailer. Results are for freight density above 13.3 lbs/ft^3 and under 11.9 lbs/ft^3 respectively
GHG standard design: Regulated entities & vehicles

- Options to consider:
  - Vehicle manufacturers, engine manufacturers, fleets
  - Phase in by class (vehicle GVWR) or vocation

- Questions to answer:
  - During vehicle design and manufacture, what party is responsible for the major decisions affecting GHG?
  - Are some market segments more important and/or “easier” to regulate first?

- Vehicle manufacturers (chassis+cab) control or coordinate most of the truck specification process for certain market segments

- In US, class 8b (long haul) and class 2b (work trucks) should be initial target
  - Large fraction of fuel use
  - Most straightforward specification process

- Vocational trucks most complex
  - Cab+chassis often sold without body
  - Is aerodynamic performance as important?
GHG standard design: Metric

Options for a vehicle standard:
- Grams per km: GHG per mile driven
- Grams/tonne-km: GHG per tonne of freight driven one km
- Grams/m³-km: GHG per cubic meter of freight driven one km

Questions to answer:
- Will a g/tonne-km or g/m³-km regulatory metric be more “effective” to reduce HDV GHG than more familiar grams/km?
- Is g/m³-km a “better” metric than g/tonne-km?

Grams/km may be appropriate if reduction targets are modest
- Reduced vehicle weight and increased trailer volume not as important in meeting g/km target

Grams/tonne-km or grams/m³-km can allow setting more aggressive targets
- Aggressive targets needed to ensure g/km improvements in addition to increases in cargo weight/volume
- Based available data, in the US approximately 50-60% of trucks cube-out and the remainder weigh-out or are empty
GHG standard design: Test procedures

**Options**
- In-use, test track, chassis dyno, simulation modeling

**Questions to consider**
- What are the strengths and weaknesses of each method in regulatory context?
- What role can simulation modeling software play?
- Can the number of test cycles required be limited while still collecting enough information to determine performance on range of duty cycles?
Purpose

- Identify a method to predict fuel economy on any duty cycle based on fuel economy data on known cycles
- In addition method must:
  - Accurately predict real-world changes in fuel economy for different HDV types and technology improvements
  - Be insensitive to gaming
  - Provide meaningful results to HD purchasers

Methodology

- Within each test cycle, there are a small number (2-4) of key characteristics that play a central role in determining fuel economy. (velocity, acceleration, etc…)
- Identify these metrics and test their combined predictive ability
- Method could be used to simplify the number of test cycles and/or vehicle tests necessary to reflect a broad range of operating conditions
Relevant ICCT Research: Simulation Models with Ricardo

- **Purpose**
  - Evaluate the suite of existing vehicle simulation models against three criteria:
    - Accuracy/sophistication
    - Ease of use
    - Cost

- **Methodology**
  - Identify major simulation tools
  - Identify major tool users, such as: major HD engine & truck manufacturers, academic institutions (U. Michigan, U. Wisconsin, Cambridge), government agencies (DOE, DOD).
  - Survey of current tool users around the world against evaluation criteria
Thank you!

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