Heavy-Duty Vehicles

Regulatory opportunities, design challenges and policy-relevant research

Fanta Kamakaté

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ON CLEAN TRANSPORTATION

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

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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

Regulatory Update: EU

- 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

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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

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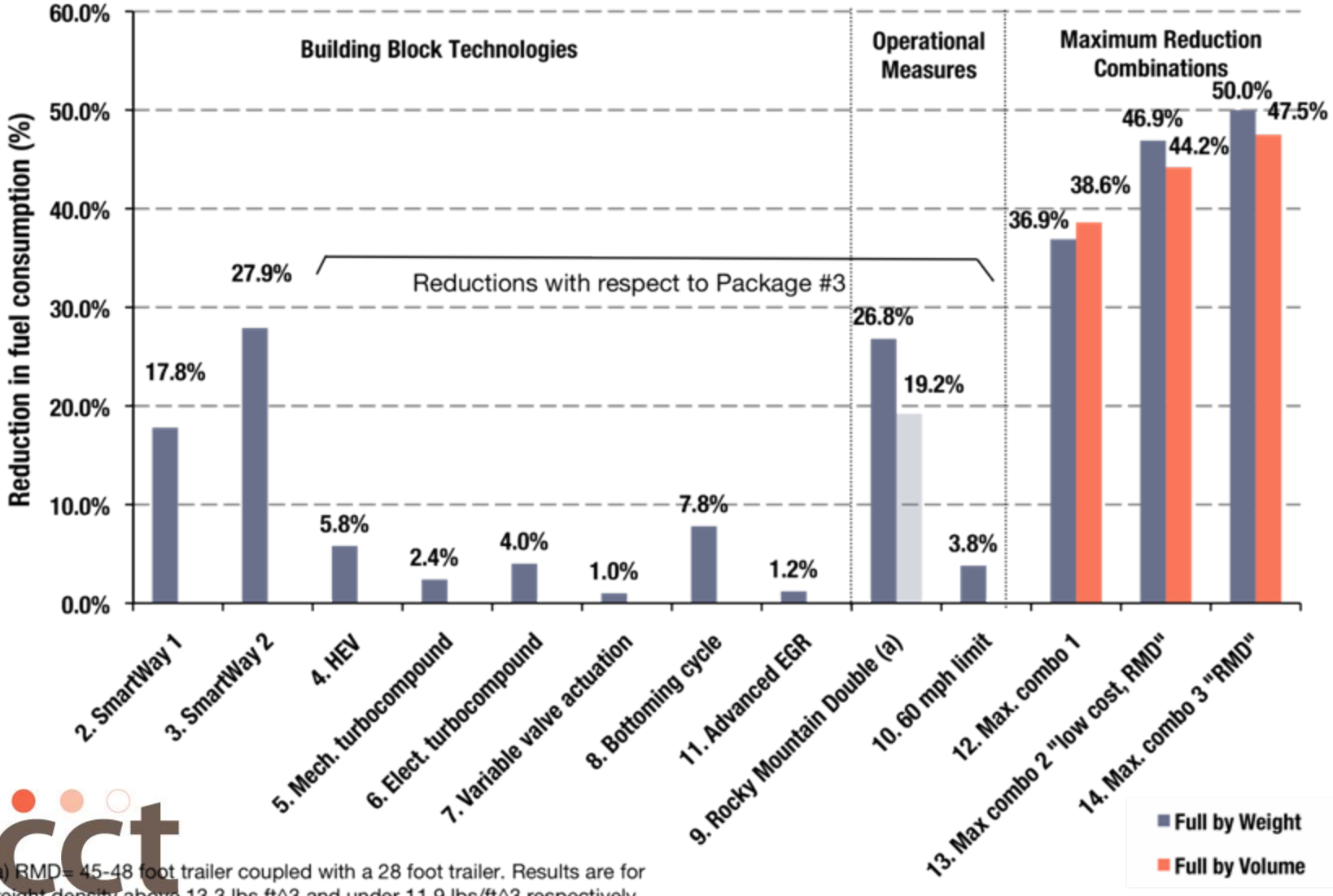
Technology Potential- NESCCAF/ICCT



(a) 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

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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/m^3-km: GHG per cubic meter of freight driven one km
- Questions to answer:
  - Will a g/tonne-km or g/m^3-km regulatory metric be more “effective” to reduce HDV GHG than more familiar grams/km?
  - Is g/m^3-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/m^3-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?

Relevant ICCT Research: Duty Cycles with WVU

- 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!

Fanta Kamakaté

One Post Street Suite 2700

San Francisco CA 94104

Tel: 415-202-5750

Fanta@theicct.org

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