POSITION BRIEF

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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

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REGULATORY DESIGN OPTIONS FOR U.S. GREENHOUSE GAS EMISSION AND EFFICIENCY STANDARDS FOR 2020 AND LATER HEAVY-DUTY VEHICLES

As the U.S. works on the next phase of the heavy-duty vehicle greenhouse gas (GHG) and efficiency standards, one of the key questions regards the regulatory design—meaning *how trucks are tested and certified*—for compliance with the rule. One of the most hotly disputed topics is whether to maintain two separate standards, one for the engine and one for the full vehicle, as is currently the case. To inform this debate, we assess regulatory design alternatives that span the range of plausible certification approaches, using the current "Phase 1" regulation and publicly expressed industry viewpoints as a guide. We distill the basic heavy-duty vehicle regulatory design options down to the following, three, certification approaches[2]:

» ***Maintain separate engine and vehicle standards as in the original regulation***. The baseline option would maintain the same certification pathway as in the existing 2014-2018 regulation, whereby there are separate vehicle and engine standards for tractor-trailers and vocational vehicles. Engine certification involves physical testing of the engine on a dynamometer. Vehicle certification is performed through simulation modeling (using the Greenhouse gas Emission Model, or "GEM").

» ***Make significant improvements and maintain separate engine and vehicle standards***. The key improvements from the Phase 1 option would be to include an option to perform powertrain (i.e., the engine plus the transmission) testing to credit advanced transmission technology and integration, improve both the engine and vehicle duty cycles in order to make them more reflective of real-world operation, and include engine- and transmission-specific inputs into the GEM vehicle certification process. This approach would ideally be coupled with new trailer regulations[3].

» ***Rely on full-vehicle simulation and eliminate separate engine standards.*** As with the previous option, this approach would add important new elements to the vehicle certification process. This approach would include the features of the second option above, but without the separate standard for engines. In eliminating the separate engine standard, the GEM vehicle simulation process would become the sole means for evaluating fuel efficiency and GHG emissions performance.

We then evaluate these options based on the following seven criteria, which were developed to reflect the certification procedure's desired features in establishing long-term heavy-duty vehicle emission and efficiency policy.

1. **Credit technology improvements.** Ensure any efficiency technologies that provide fuel savings and GHG reductions can be accounted for their relative benefits.
2. **Technology investment.** Ensure promotion of long-term efficiency investments in the engine, transmission, as well as in vehicle-level systems to match the stringency of the rule.

2 *See greater detail and examination for six certification pathways in the full paper: Sharpe, Delgado, Muncrief (2014). Comparative assessment of heavy-duty vehicle regulatory design options for U.S. greenhouse gas and efficiency regulation.* www.theicct.org/assessment-us-hdv-regulatory-options

3 *See Sharpe, Delgado, Lutsey (2014). Benefit-cost analysis of integrating trailers into heavy-duty vehicle efficiency regulation.* http://www.theicct.org/integrating-trailers-hdv-regulation-benefit-cost-analysis

3. **Acknowledge market structures.** Account for how individual engines and powertrains can be sold into multiple different vehicle platforms.
4. **Real-world confidence.** Ensure end users, society, and regulators have confidence that the efficiency improvements on the regulatory tests result in comparable, durable real-world benefits.
5. **Cost-effective.** Encourage cost-effective technology deployment and investment decisions.
6. **Minimize regulatory burden.** Ensure test procedures and enforcement provisions minimize the burden for government and regulated entities.
7. **Accord with criteria emissions.** Ensure that fuel consumption and GHG targets are met without compromising very low in-use criteria pollutant emission levels.

Table 1. Comparison of certification pathway options in the heavy-duty vehicle efficiency regulation

Option	Key characteristics	Pros (+)	Cons (–)
Maintain original certification	• Separate engine and vehicle standards • Unclear credit for improved transmission • Engine and vehicle cycles with poor link to real-world operations • Generic powertrain data	• Acknowledges market structures • Minimizes compliance burden • Linked to criteria pollutant standards	• Does not sufficiently credit all efficiency improvements • Does not promote improvements in all technology areas • Does not provide confidence of real-world savings
Improve certification testing and data	• Separate engine and vehicle standards • Optional test to credit transmission technology • Improved duty cycles • Engine and transmission specific inputs in vehicle simulation model	• Properly credits all efficiency improvements • Promotes improvements in all technology areas • Acknowledges market structures • Provides confidence of real-world savings • Linked to criteria pollutant standards	
Full vehicle simulation (eliminate engine standard)	• Full-vehicle standard only • Optional test to credit transmission technology • Improved duty cycles • Engine and transmission specific inputs in vehicle simulation model	• Properly credits all efficiency improvements • Provides confidence of real-world savings • Encourages cost-effective technology investment	• Does not reliably promote improvements in engine • Does not acknowledge market structures

We evaluate the certification options' relative merits along the seven criteria, where we determine how well each option captures the essence of that criterion (positive, negative, or neutral). Table 1 summarizes the main pros and cons associated with each option.

Based on our evaluation, the middle certification option is best. The modifications in the duty cycles and powertrain data inputs would greatly improve the regulation's ability to promote real-world energy and emission benefits. Maintaining the separate engine testing requirements remains key to reliably promoting long-term investments in engine technology and acknowledging the current market structure. Therefore, we recommend that the next phase of the regulation maintain a separate program while making the recommended improvements to the certification method.

The full assessment is available at **www.theicct.org/assessment-us-hdv-regulatory-options**

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