ICCT comments on EPA’s proposed heavy-duty engine and vehicle standards

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How did we get here?

2001: EPA adopts PM and NO\textsubscript{x} engine standards through model year 2010: \textit{200 mg/bhp-hr}

... 

Jan 2020: EPA publishes \textit{Advance Notice of Proposed Rulemaking (ANPR)}

Aug 2021: President Biden issues an executive order asking EPA to:

- consider new NO\textsubscript{x} emission standards starting in model year 2027
- consider revising Phase II GHG standards and the role of ZEVs in model years 2027–2029
- consider a Phase III GHG standard starting as soon as model year 2030

Dec 2021: California HDV Omnibus regulation finalized: \textit{20 mg/bhp-hr}

Feb 2022: EPA releases \textit{Notice of Proposed Rulemaking (NPRM)} \textit{**actual proposal**}

May 2022: public comment deadline
COVID-19 has revealed the central role of HDVs in pollution exposure disparities

“… targeting NO$_x$ emissions from heavy-duty diesel vehicles is likely the most effective strategy for reducing disparities nationwide.”

- Hunter et al. (2021)

Disparities in NO$_2$ exposure pre- and post-COVID

EPA’s proposal, in a few bites

<table>
<thead>
<tr>
<th>NOx</th>
<th>GHGs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option 1</strong>: 90% reduction in NOx limits by 2031, with longer useful life and warranty periods</td>
<td></td>
</tr>
<tr>
<td><strong>Option 2</strong>: 75% reduction in NOx, less stringent useful life and warranty</td>
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</table>

**Both Options:**
- Endless ZEV crediting
- Inducement provisions that could lead to higher in-use emissions

**GHGs**
- Tightens 2027 standards by 1.5% for school and transit buses, delivery vans, and short-haul tractors
- Maintains ZEV supercrediting until 2028 (4.5x for a BEV)
- Requests comment on setting a ZEV requirement

**NOx**

**GHGs**

**ZEV**: zero-tailpipe-emission vehicles including battery-electric and hydrogen fuel cell vehicles
ICCT’s recommendations

<table>
<thead>
<tr>
<th>NO\textsubscript{x}</th>
<th>GHGs</th>
</tr>
</thead>
<tbody>
<tr>
<td>© Dismiss Option 2</td>
<td>© Set minimum ZEV production requirements to achieve 20%, 30% and 40% ZEV sales in 2027, 2028 and 2029</td>
</tr>
<tr>
<td>© Strengthen Option 1, including:</td>
<td>© Preserve the original Phase II stringency for ICE vehicles</td>
</tr>
<tr>
<td>© 90% reduction in NO\textsubscript{x} limits by 2027</td>
<td>© Phase-out ZEV supercrediting towards GHGs in 2024 or as soon as feasible</td>
</tr>
<tr>
<td>© Strengthen SCR inducements,</td>
<td></td>
</tr>
<tr>
<td>including lowering speed derates and removing overrides of disincentives</td>
<td></td>
</tr>
<tr>
<td>© Do not allow ZEV crediting</td>
<td></td>
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</tbody>
</table>
NO\textsubscript{x}
Updated NO\textsubscript{x} standards are technically feasible

Various technology pathways can achieve 20 mg/hp-hr NO\textsubscript{x} emissions

- Demonstrated by SwRI
  - Up to 800k miles
  - 2% FTP compliance margin

Source: SwRI 2022. SAE presentation

Ongoing project in Europe at the vehicle level in real world use

Updated NO\textsubscript{x} standards are economically feasible

Conducted using anonymous survey of EMA members

Cost-benefit breakeven

$53,400

ZEV crediting would allow OEMs to produce higher emitting diesel engines

Share of diesel engines that can be certified at the FEL cap by model year and scenario under Option 1

Family emission limit (FEL) cap: maximum limit an engine can be certified to, even if credits would allow it to go higher. For most HDVs, the EPA proposed limit is 150 mg/hp-hr in 2027 and 50 mg/hp-hr in 2031.
Stricter NO$_x$ regulations reduce HDV NO$_x$ emissions

Choosing Option 1 over Option 2 avoids nearly 1 million tonnes of NO$_x$ emissions between 2027 and 2050

Not considered:
- Inducements
- In-use testing
- New test cycles
Stricter NO$_x$ regulations reduce HDV NO$_x$ emissions

Cumulative tailpipe NO$_x$ emissions by scenario, 2027–2050

MOU: EPA 2010

- EPA Option 2: -38%
- EPA Option 1: -44%
  - with lower FEL cap: -45%
  - with no ZEV crediting: -46%
- Federal omnibus: -47%

Limiting or eliminating ZEV crediting achieves some of the benefits of adopting a federal omnibus.

These benefits increase with accelerated ZEV deployment.

EPA 2010 standards are currently in effect.
EPA’s proposed Option 1 would allow ZEV crediting.
Federal omnibus assumes full alignment with California’s Omnibus rule starting in 2027.
Key recommendations on $\text{NO}_x$ standards

1. We encourage EPA to finalize $\text{NO}_x$ engine standards this year.
2. We recommend EPA adopt a strengthened Option 1 to fully align with a 90% $\text{NO}_x$ reduction in model year 2027.
3. We recommend EPA eliminate ZEV crediting towards $\text{NO}_x$ engine standard compliance.
4. We recommend EPA strengthen proposed SCR inducement provisions.
GHGs
Accelerating ZEV uptake prior to 2030 is crucial to put the sector on a pathway compatible with 2°C.

**Cumulative well-to-wheel CO₂ emissions by scenario, 2027–2050**

<table>
<thead>
<tr>
<th>6-state ACT adoption</th>
<th>Current</th>
<th>Proposal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>65%</td>
<td>65%</td>
</tr>
<tr>
<td></td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>gigatonnes CO₂</td>
<td>12.6 Gt</td>
<td>12.5 Gt</td>
</tr>
</tbody>
</table>

EPA’s proposed revisions to the GHG standard will reduce cumulative class 4-8 vehicle CO₂ emissions by **only 0.4%** from 2027–2050.
Accelerating ZEV uptake prior to 2030 is crucial to put the sector on a pathway compatible with 2°C.

Incorporating ICCT’s recommendations to preserve ICE stringency could more than double the benefits of expected actions by MOU states.
Accelerating ZEV uptake prior to 2030 is crucial to put the sector on a pathway compatible with 2°C.

A 3-year lag in ACT stringency reduces CO₂ benefits by 1.2 Gt and is not compatible with 2°C. More is needed for compatibility with limiting warming to 1.5°C.
Under EPA’s proposal, model year 2027 ICE vehicles could emit more than in model year 2017

Efficiency improvements required for ICE vehicles by ZEV pathway and GHG standard.

<table>
<thead>
<tr>
<th>ZEV pathway</th>
<th>GHG standard</th>
<th>Rigid trucks and buses</th>
<th>Tractor trucks</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ZEV deployment</td>
<td>Current</td>
<td>14%</td>
<td>22%</td>
<td>15%</td>
</tr>
<tr>
<td>6-state ACT adoption</td>
<td>Current</td>
<td>3%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>Proposal</td>
<td>4%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>MOU states adopt ACT</td>
<td>Proposal</td>
<td>-1%</td>
<td>-19%</td>
<td>-3%</td>
</tr>
<tr>
<td></td>
<td>Proposal, no ZEV supercredits</td>
<td>11%</td>
<td>14%</td>
<td>11%</td>
</tr>
<tr>
<td>ICCT</td>
<td></td>
<td>14%</td>
<td>22%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Current: EPA maintains the original Phase II GHG standards.
Proposal: EPA tightens the Phase II GHG standards by 1.5% for certain segments, as proposed in the NPRM.
ICCT: EPA removes ZEV crediting and requires all ICE to meet the original Phase II GHG standards.
Key recommendations on GHG standards

1. We encourage EPA to finalize GHG standards this year

2. We recommend EPA set minimum ZEV production requirements of 20%, 30%, and 40% in 2027, 2028 and 2029

3. We recommend EPA preserve the original Phase II stringency for ICE vehicles

4. We recommend EPA phase-out ZEV supercrediting towards GHGs in 2024 or as soon as feasible
Questions?
Additional slides
EPA Option 1 vs. California Omnibus

**NO\textsubscript{x} Limits:**
2027: Option 1 *weaker* than Omnibus for most vehicle categories and the same for heavy-heavy duty diesel.
2031: Option 1 *same* as Omnibus for all vehicle categories.

**Useful life:**
*Same* as Omnibus for all categories.
Intermediate useful life for heavy-heavy-duty diesel starts in 2031 instead of 2027 (*weaker* than Omnibus).

**ZEV Crediting:**
Option 1 *weaker* than Omnibus on diesel engines because it allows ZEV crediting with no sunset date.

**Inducements:**
Option 1 *weaker* on inducement provisions than Omnibus.

**In-Use Testing:**
Option 1 keeps Not-to-Exceed test procedure, which is *weaker* than Omnibus 3-Bin Moving Average Window.

*Not modeled in our analysis*
Because of ZEV supercrediting, GHG emissions would be higher under current state-level action on ZEVs than without any ZEV deployment.

Removing ZEV supercredits has roughly half of the benefit of removing all ZEV credits.

Increasing ZEV uptake is necessary to achieve substantial GHG emission reductions.

MOU: (Multi-state) memorandum of understanding
ACT: Advanced Clean Trucks Rule
ACF: Advanced Clean Fleets Rule (9/9/2021 draft)
## Summary of literature on ZEV market details

<table>
<thead>
<tr>
<th>Segment</th>
<th>Segment Description</th>
<th>Share of HDV sales</th>
<th>Year of TCO parity between ZEVs and ICEVs</th>
<th>Upfront cost ratio of ZEVs to ICEVs in 2027</th>
<th>Market readiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td>Transit buses primarily class 8</td>
<td>1.3%</td>
<td>Before 2025</td>
<td>1-1.1</td>
<td>Mature market, depot charging</td>
</tr>
<tr>
<td></td>
<td>Refuse trucks primarily class 8</td>
<td>0.7%</td>
<td>Before 2025</td>
<td>1.1-1.15</td>
<td>Small-scale commercialization, depot charging</td>
</tr>
<tr>
<td></td>
<td>Short-haul rigid trucks class 4-7 (e.g., delivery, utility)</td>
<td>40.1%</td>
<td>2022 (Class 4) - 2027 (Class 7)</td>
<td>0.9-1.5</td>
<td>Small-scale commercialization, depot charging</td>
</tr>
<tr>
<td>Medium</td>
<td>Short-haul rigid trucks class 8 (e.g., delivery, utility)</td>
<td>15.7%</td>
<td>2028</td>
<td>1.45-6</td>
<td>Approaching commercialization, depot charging</td>
</tr>
<tr>
<td></td>
<td>Short-haul tractors primarily class 8 (e.g., drayage, beverage)</td>
<td>8.6%</td>
<td>2025-2033</td>
<td>1.3-1.8</td>
<td>Approaching commercialization, depot charging</td>
</tr>
<tr>
<td></td>
<td>School buses primarily class 6-7</td>
<td>4.9%</td>
<td>2026</td>
<td>1.25</td>
<td>Mature market, depot charging, some limitations in rural areas</td>
</tr>
<tr>
<td></td>
<td>Other buses (e.g., shuttle buses, regional transit)</td>
<td>3.3%</td>
<td>2027-2030</td>
<td>1-1.2</td>
<td>Mixed charging requirements</td>
</tr>
<tr>
<td>Slow</td>
<td>Long-haul rigid trucks class 4-8</td>
<td>2.5%</td>
<td>After 2030</td>
<td></td>
<td>Mixed charging requirements</td>
</tr>
<tr>
<td></td>
<td>Long-haul tractors primarily class 8</td>
<td>15.0%</td>
<td>No Consensus</td>
<td>2-2.4</td>
<td>Approaching range-limited commercialization, requires significant publicly accessible charging</td>
</tr>
</tbody>
</table>

Not shown: Motorhomes (8.0% of sales).

Sources: [ANL](https://www.anl.gov), [ANL’s BEAN tool](https://www.anl.gov/bean), [NREL](https://www.nrel.gov) (2021), [NREL](https://www.nrel.gov) (2022), [EDF](https://www.edf.org), [CARB](https://www.cARB.gov), [ZEV Alliance](https://www.zevalley.org)