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For subscription or editorial enquiries please contact:

Email: Info@rhomotion.com

Tel: +44 (0) 203 286 8936

Key Takeaways:

- The EPA proposes new standards for vehicle CO₂ emissions for OEMs out to 2032 (56% reduction from the 2026 target for LDV).
- According to EPA estimates, up to 67% of new LDV vehicles sold in 2032 may have to be electric in order for carmakers to be compliant.
- The proposed standard would avoid 7.3 billion tons of CO₂ emissions.
- The EPA is proposing to end refrigerant-based credits in Model Year (MY) 2027, to limit off-cycle credits and AC efficiency credits to vehicles equipped with an IC engine, and to phase-out off-cycle credits.
- EPA proposes new GHG standards for heavy-duty highway vehicles, with CO₂ standards set out across 101 heavy duty vehicle types.
- EPA sets Battery Durability and Warranty requirements for BEVs and PHEVs.
- The deadline for comments on the two proposed rules is 30 days after they are published in the Federal Register.

Impact & Cost

The proposed standards would result in **net reductions of emissions of criteria air pollutants and GHGs in 2055**. The GHG emission reductions would contribute toward the goal of holding the increase in the global average temperature to well below 2°C above pre-industrial levels and would subsequently reduce the probability of severe climate change related impacts including heat waves, drought, sea level rise, extreme climate and weather events, coastal flooding and wildfires.

The **benefits** include climate-related economic benefits from:

- Reducing emissions of GHGs that contribute to climate change
- Reductions in energy security externalities caused by U.S. petroleum consumption and imports
- The value of certain particulate matter-related health benefits
- The value of additional driving attributed to the rebound effect
- The value of reduced refuelling time needed to refuel vehicles (with higher EV penetration this results in negative economic benefit)

The EPA estimates the present value of net benefits lies in the range of **\$850 billion to \$1.6 trillion**. It also estimates that the total benefits of this proposal far exceed the total costs.

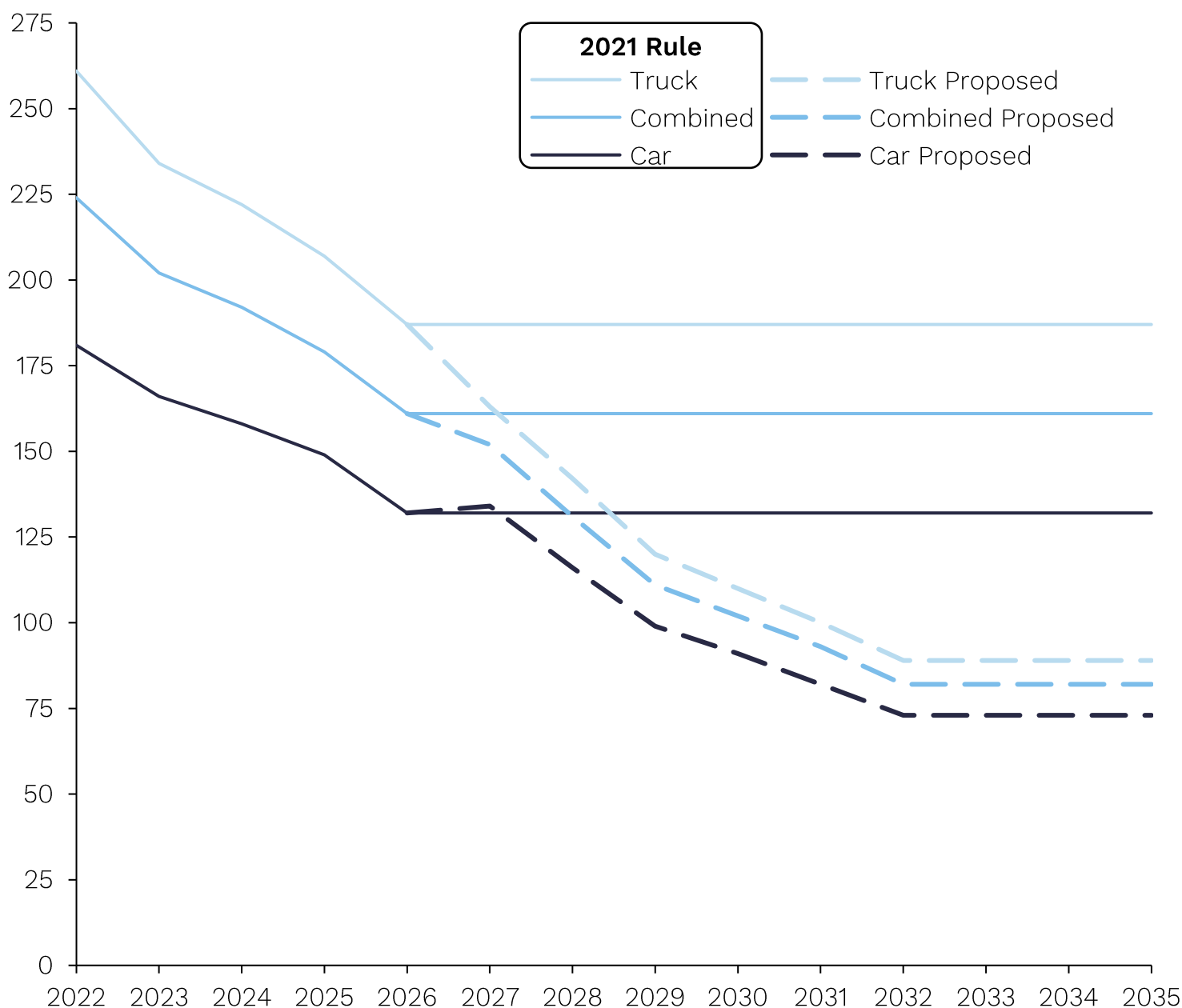


Light-duty Vehicle New CO₂ Emissions Standards Proposal

Below are the proposed new CO₂ emissions standards for Light-duty Passenger Vehicles set by the EPA compared to the previous rule made by the Biden administration in 2021. The proposal results in a dramatic reduction in 2032 compared to the previous set level which was due to level off after 2026.

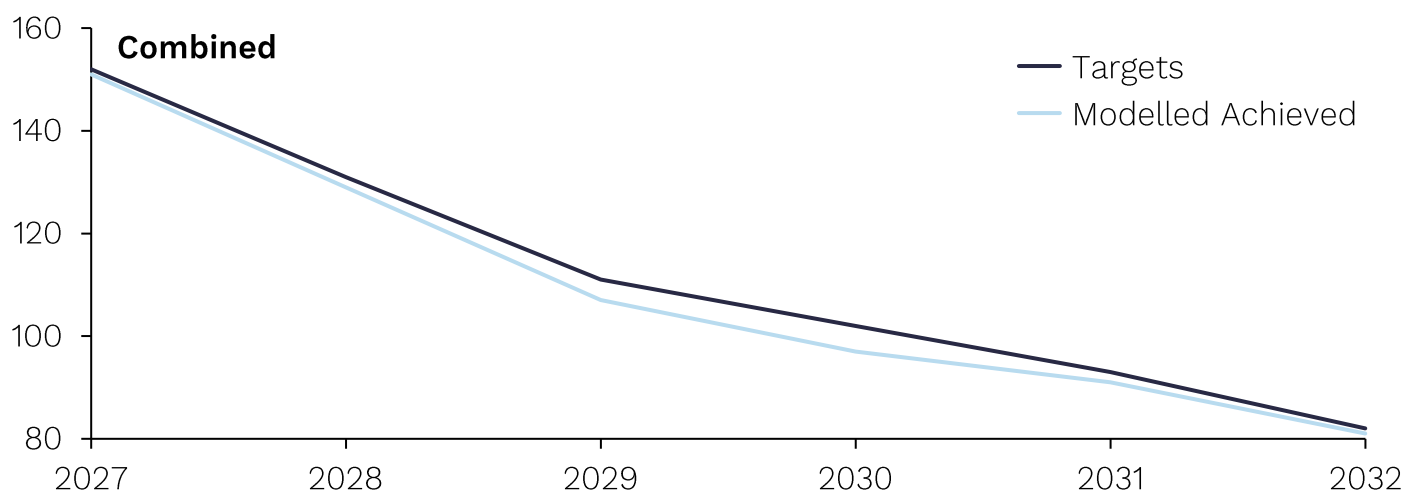
CO₂ Emissions Standards Current and Proposed

CO₂ g/mile

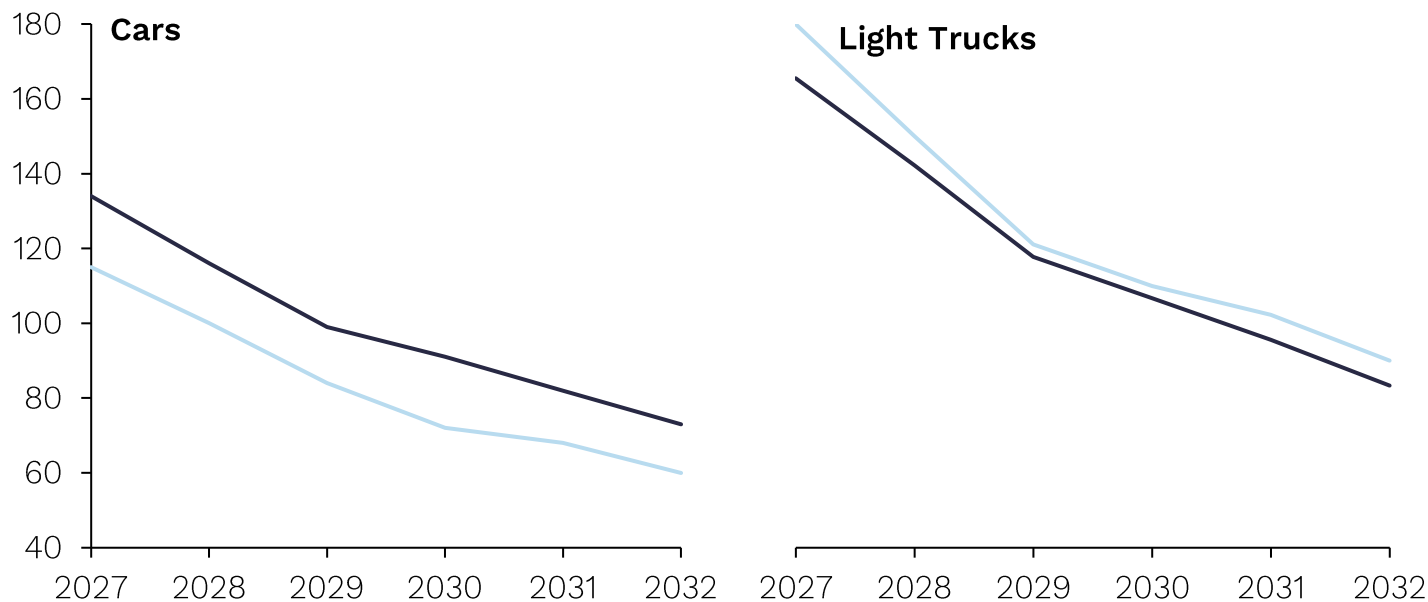


LDV & MDV Proposed Targets vs the modelled expectation of what will be achieved

CO₂ g/mile



CO₂ g/mile



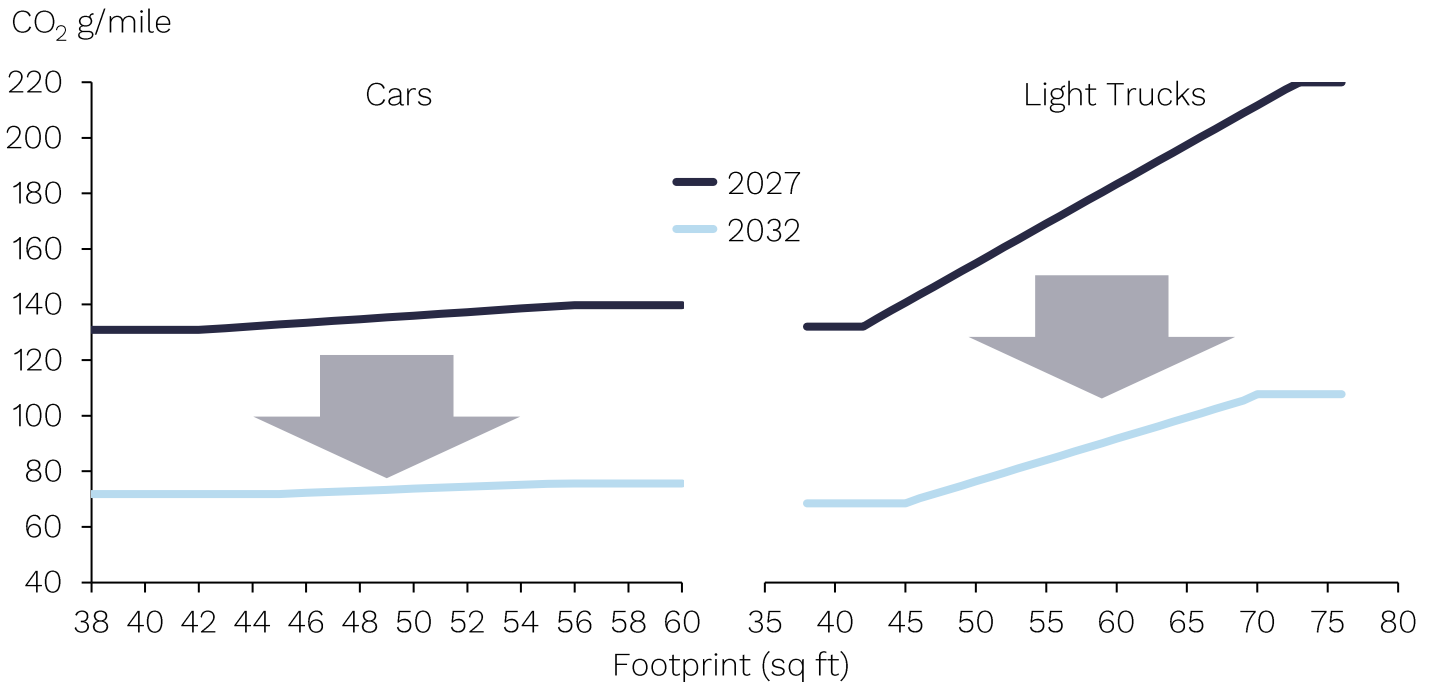
Comparing the target and the modelled achieved values it can be seen that the achieved values are over target (higher emissions) for the average truck, and under target (lower emissions) for the average car. Overall, the over-achievement of the car segments will be making up for the higher emissions and under-achievement of the pickup-truck segment. This may also have the effect of incentivising OEMs to move their vehicle mix closer to the car segments over time as these goals may be seen as more achievable.

The over-achievement modelled overall allows for credits to be rolled over from one year to another as well as traded between OEMs.



Individual OEM targets are based on the footprint of the vehicles they sell

Footprint standards for cars and light trucks

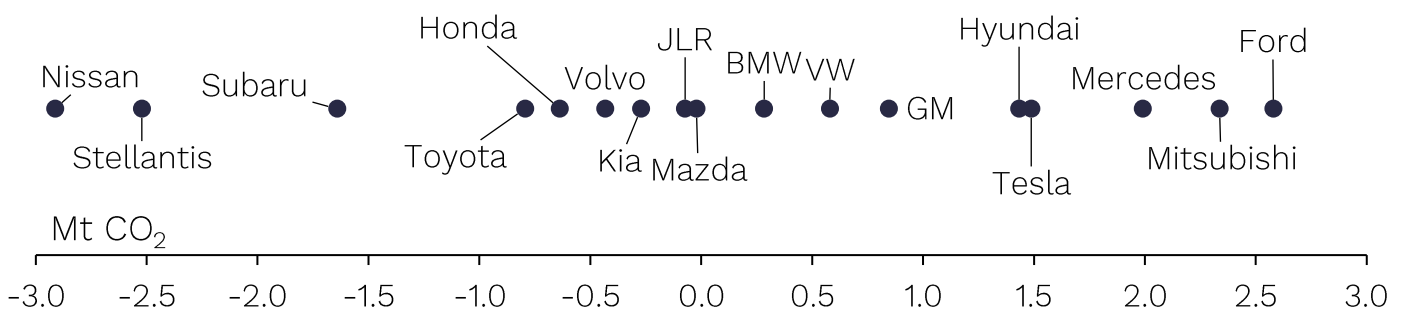


OEM targets will be set based on the makeup of the vehicles they have sold. Where in Europe this is done in a similar way based on the weight of the vehicle, these standards will use the footprint of the vehicle. In general, these are higher for light trucks than for cars.

Above, we have plotted what these standards look like for cars and trucks in 2027 and 2032. The standards do become more stringent every year but for simplicity, just the start and end are shown.

The standards generally allow for a higher rate of emissions for larger footprint vehicles. This is more dramatic for light trucks to incorporate greater towing capacity at the higher end. Over time not only do the curves translate lower but also the gradient of the slope between the minimum and maximum levels flattens, this will mean larger vehicles, especially trucks cannot ignore electrification under this proposal.

In the rule specific targets are made for each OEM, below is the calculated difference between the targeted emissions and the achieved emissions in the modelling for a combined fleet sales in the year 2032. Those in the positive will be able to sell credits to those in the negative.





Projected Technology Penetrations

The proposed standards are performance-based and do not mandate any specific technology for any manufacturer or any vehicle type. Each manufacturer is free to choose its own set of technologies with which it will demonstrate compliance with the standards.

However, using its internal modelling, OMEGA, the EPA has set expectations on how this will play out in terms of the penetration of BEVs on the road. The modelling is comprehensive and takes into account a range of factors that will be crucial in determining the penetration rate that EVs can reach. This includes provisions for the redesign periods of manufacturers, limits to the rate at which manufacturers can ramp from ICE to BEV, the time needed to increase the availability of raw materials and expand battery production facilities.

Battery production was not expected to be a bottleneck due to the number of planned facilities expected to operate in the region. In terms of a limiting factor, the supporting documents state: *“On a sheer quantity basis and probably also on a value basis, battery minerals are likely to be the most important mineral-related constraint on PEV production during the time frame of the rule”*. For these raw materials, Lithium was used as the limiting factor. This was due to its unicity in all battery chemistries for EVs today where other materials may be substituted with varying chemistries.

The model, OMEGA, takes metrics from a broad selection of advanced vehicle technologies including ICE advancements, HEVs and BEVs. It then applies these technologies to the fleet in the most cost-effective way in which manufacturers can effectively reach compliance.

BEV Penetration rates, by body style, under proposed standards.

	2027	2028	2029	2030	2031	2032
Sedans	45%	53%	61%	69%	73%	78%
Crossovers/SUVs	38%	46%	56%	59%	61%	62%
Pickups	11%	23%	37%	45%	55%	68%
Total	36%	45%	55%	60%	63%	67%

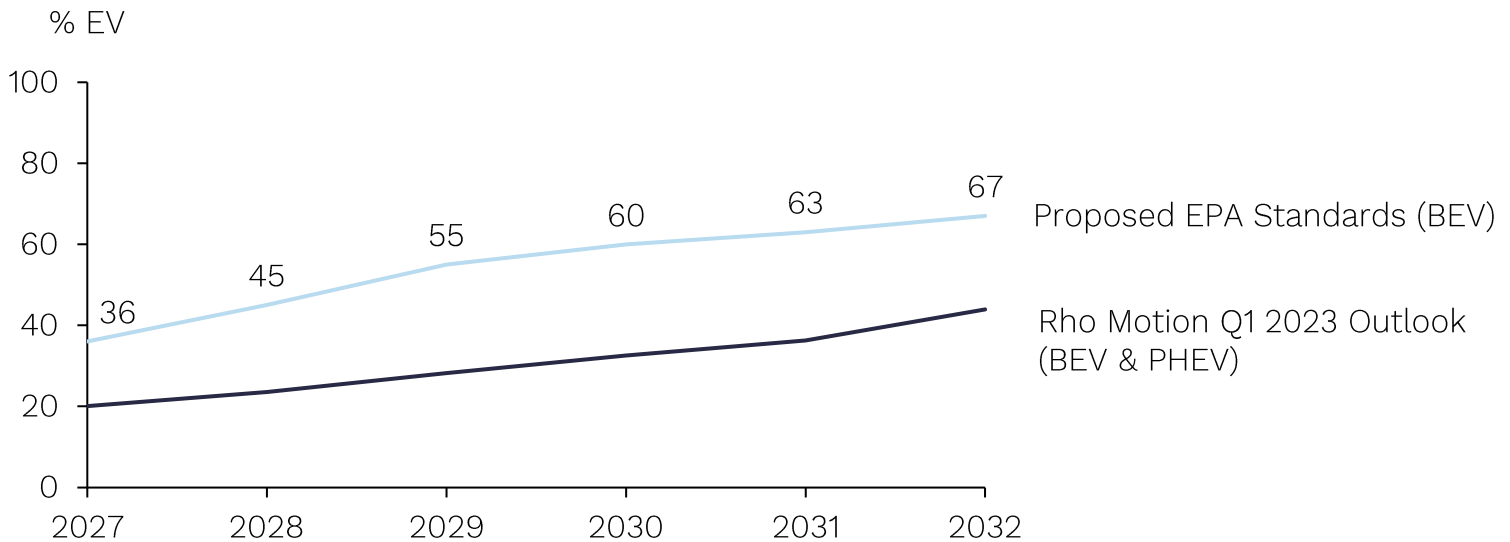
It is important to note that EPA's current analysis does not include PHEVs, however for the final rule they will include PHEVs. This means the penetration rate for overall EVs (BEV and PHEV) will likely be even higher than this, however, due to PHEVs likely having a positive contribution towards meeting the standards compared to HEV or ICE technology this could result in the BEV percentage falling compared to the figures displayed above.

Interestingly, the EPA projections have HEV technology peaking at only around 3% in the first year of the new standards, penetration falls away from there towards zero due to the projected falling cost of batteries improving the cost-effectiveness of BEVs by comparison.



PC & LDV EV Penetration, Rho Motion Q1 2023 EV & Battery Outlook vs new proposed EPA standards

The EPA estimates the proposed standards will result in a required 67% BEV share by 2032.

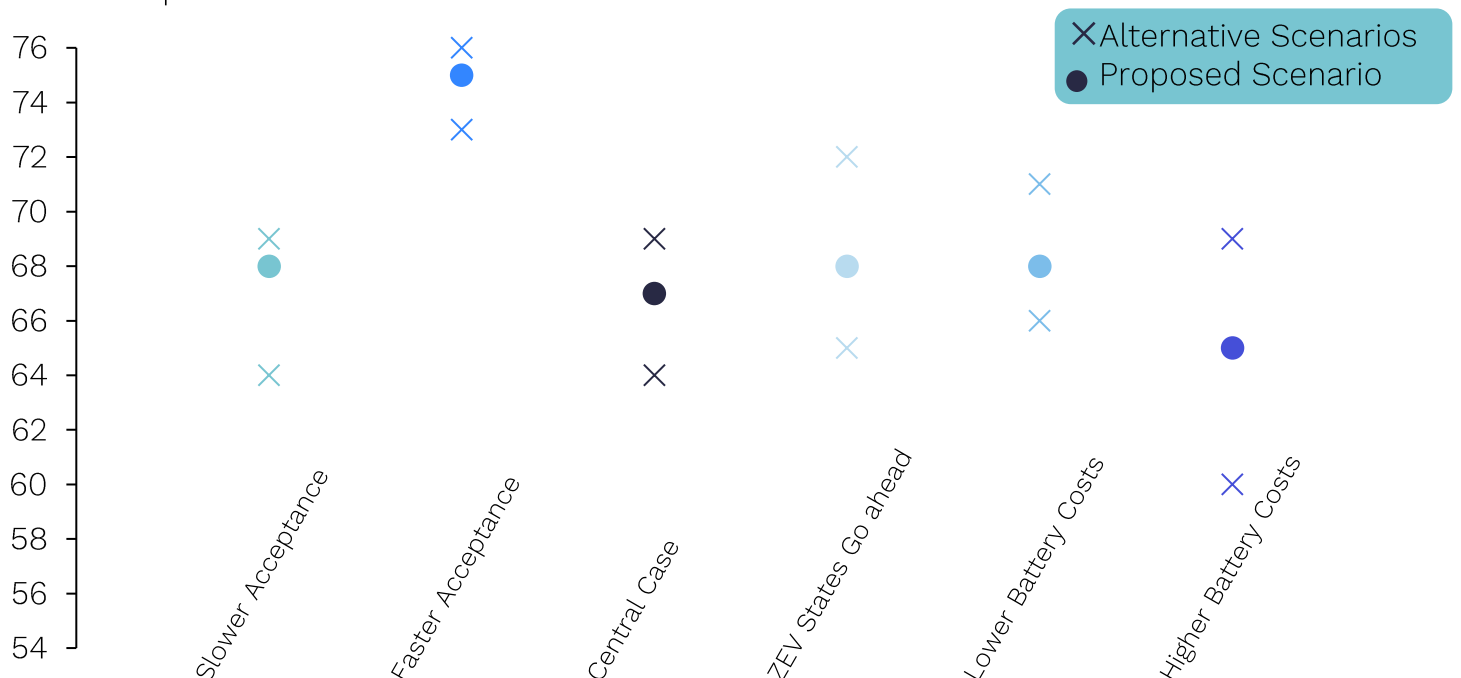


Comparison of alternative scenarios

The EPA proposes a range of alternative scenarios based on sensitivity of different factors within the modelling.

The alternative scenarios are based on average standards that are 10g/mi harsher and 10g/mi more lenient than the proposed regulation. The higher battery costs are 25% higher and the lower ones 15% lower than the central case.

2032 BEV penetration %





Medium-duty Vehicles New CO₂ Emissions Standards Proposal

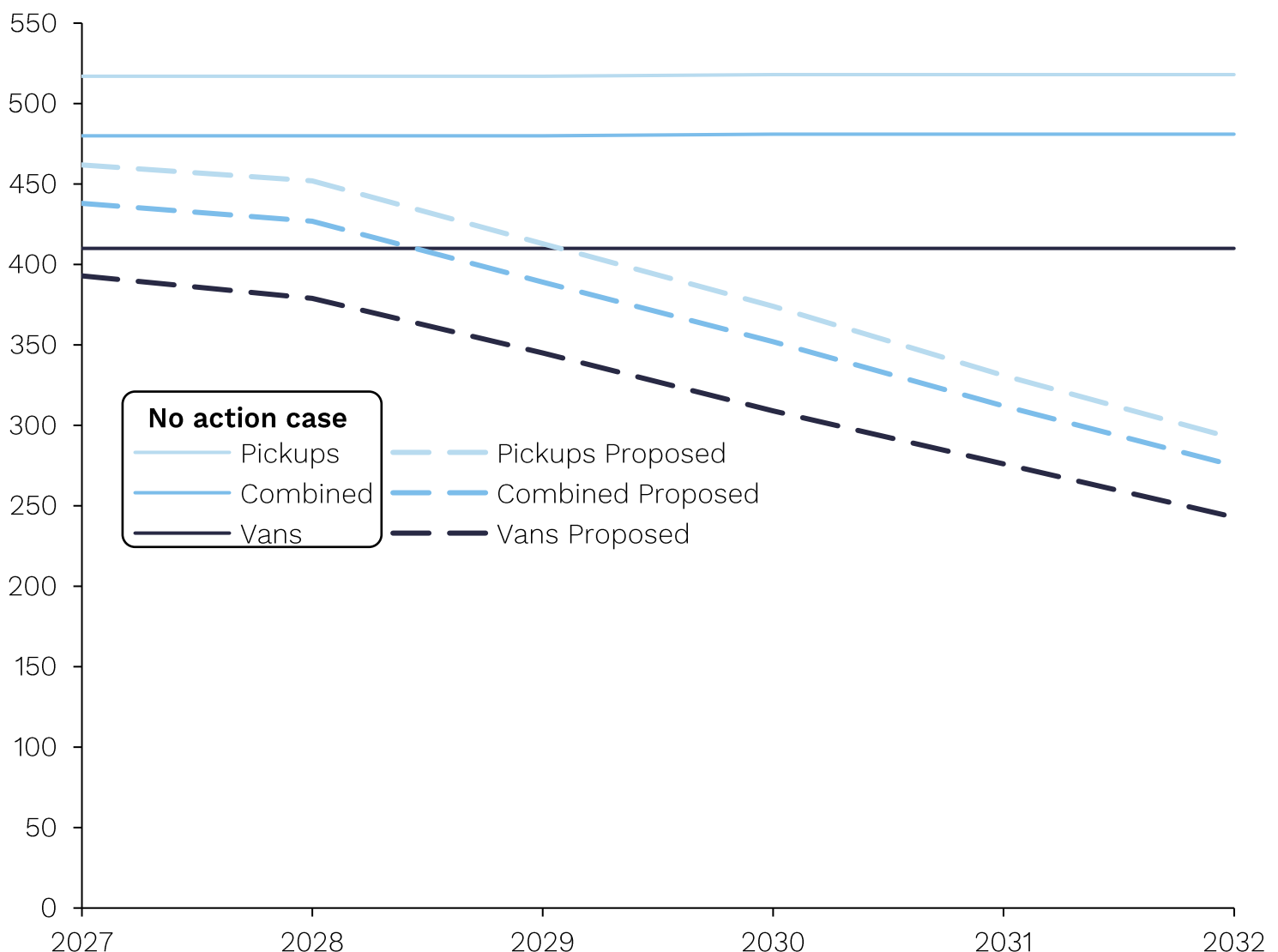
Below is the proposed new CO₂ emissions standards for Medium-duty Vehicles set by the EPA compared to the no action case. The proposal results in a dramatic reduction in 2032 compared to the no action scenario.

The Medium-duty (vans and pickups) classification is newly created, previously covered under heavy duty which incorporates;

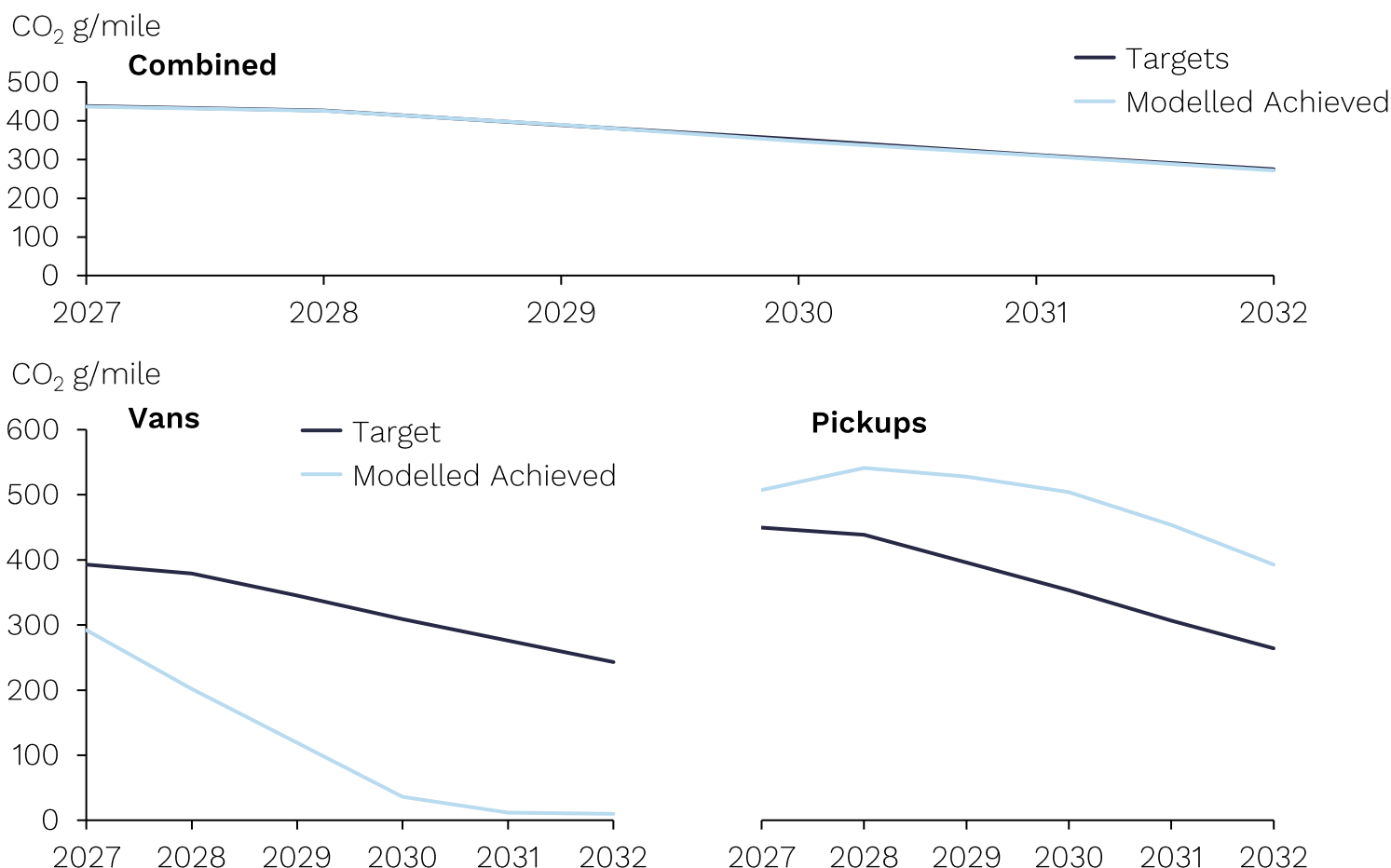
- Class 2b – 8,501 lbs to 10,000 lbs (3,855 - 4,535 kg) gross vehicle weight
- Class 3 – 10,001 lbs to 14,000 lbs (4,536 - 6,350 kg) gross vehicle weight

CO₂ Emissions Standards no action and Proposed

CO₂ g/mile



Medium-duty Vehicle Proposed Targets vs the modelled expectation of what will be achieved



Comparing the target and the modelled achieved values it can be seen that the achieved values are significantly over target (higher emissions) for the average pickup, and under target (lower emissions) for the average van. This is in line with expectations of easier electrification of vans (final mile delivery) compared to pick ups.

Medium-duty Vehicles Projected Technology Penetrations

The penetration rates are also aggressive from this modelling. The electrification of vans is expected to be especially strong. Though it is not clear why the penetration rate of pickups falls dramatically from 2027 to 2028 and does not recover until 2031.

BEV Penetration rates, by body style, under proposed standards.

	2027	2028	2029	2030	2031	2032
Vans	35%	55%	73%	92%	97%	98%
Pickups	7%	1%	3%	4%	15%	19%
Total	17%	20%	28%	34%	43%	46%



Heavy-duty Proposed Emissions

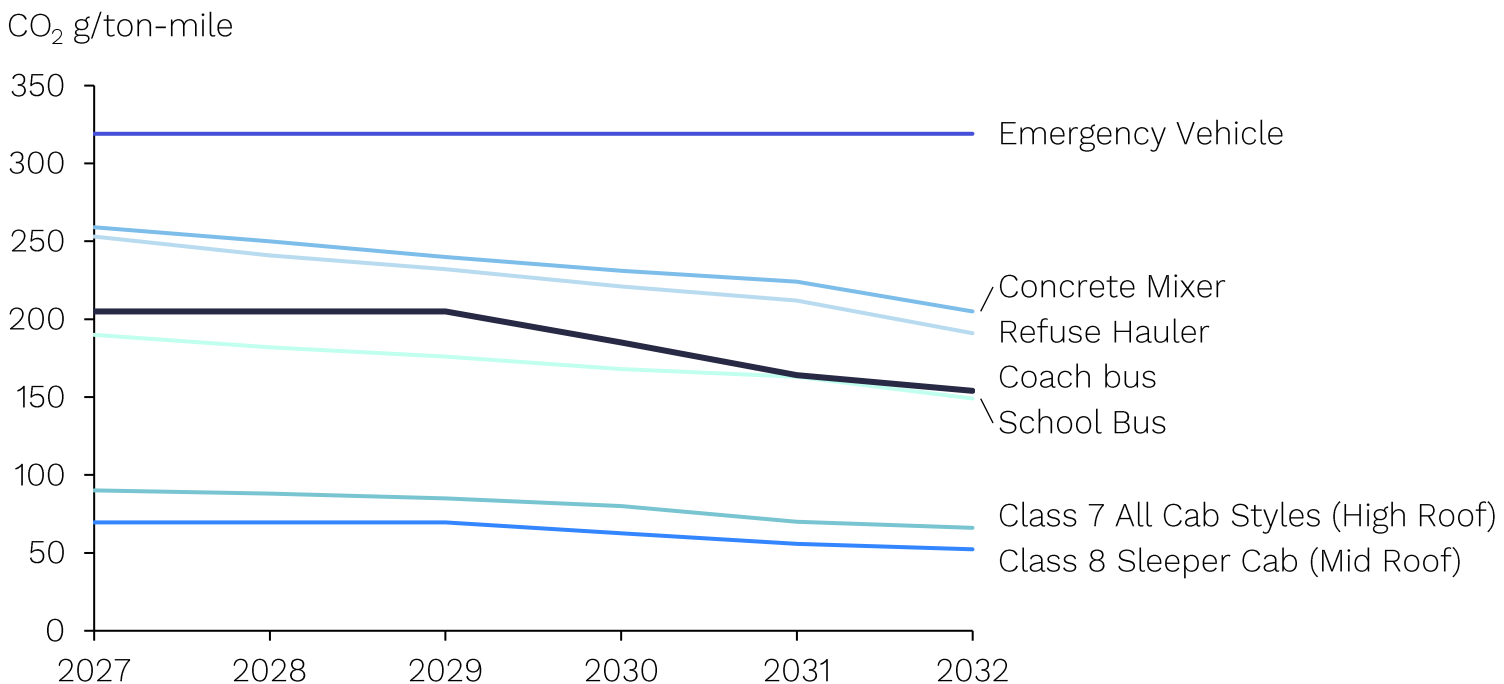
The EPA is proposing **new GHG standards for heavy-duty highway vehicles** starting in MY 2028 through MY 2032 and to revise certain GHG standards for MY 2027 that were established previously under EPA's Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 rule ("HD GHG Phase 2").

The proposed standards do not mandate the use of a specific technology, and EPA anticipates that a compliant fleet under the proposed standards would include a **diverse range of technologies, including ZEV and ICE vehicle technologies**.

The EPA sets out proposed CO₂ standards across **101 heavy-duty vehicle types**, allowing for a higher level of requirements than previous standards, particularly in markets where electrification may be considered easier (e.g., school buses, urban buses, pick-up and delivery vehicles, drayage trucks, etc.).

Note the unit for setting targets for heavy-duty vehicle classes is CO₂ g/ton-mile to account for the large variation in vehicle weight and payload, both loaded and unloaded. As a comparison a school bus typically weighs around 12t, and a Class 8 can weigh up to three times as much at 36t fully loaded. If we assume the vehicles are operating at these weights, the targets set for 2032 are at a similar level.

A sample of proposed CO₂ emission standards, (7 of the 101 standards set)



These new targets have been enabled by significant developments in ZEVs in the heavy-duty vehicle classes in recent years, both in terms of policy support and manufacturing. The EPA quotes the falling cost of manufacturing, increased investment, the 2021 Bipartisan Infrastructure Law and 2022 Inflation Reduction, as well as the California passing of the ACT program requiring zero-emission vehicles.



Battery Durability & Warranty

The proposed EPA battery durability and warranty program would create requirements for the additional testing of BEVs and PHEVs several times during their life. The EPA has been working with the UN Economic Commission for Europe (UNECE) Working Party on Pollution and Energy to develop a Global Technical Regulation (GTR No. 22) for In-Vehicle Battery Durability for EVs for several years. The EPA proposal for battery durability is largely in line with this standard, with minor adaptations to incorporate established EPA test procedures and achieve specific program objectives. Manufacturers will be required to develop and implement an on-board battery SOH monitor and demonstrate its accuracy through in-use vehicle testing.

GTR No. 22

Establishes a framework for regulating battery durability of BEVs and PHEVs by establishing durability metrics, durability performance monitoring requirements, minimum performance requirements, and procedures for monitoring accuracy and determining compliance. It does not include battery warranty requirements. To monitor durability performance, it requires that manufacturers implement two ways of monitoring battery state-of-health (SOH): State of Certified Energy (SOCE) and State of Certified Range (SOCR).

The EPA proposes a Minimum Performance Requirement specifying **SOCE** at two points in the vehicle's life, SOCR defined in the GTR would not be required. This standard will apply just to light-duty BEVs and PHEVs at this stage, due to the early stage of adoption for medium-duty vehicle classes, however monitoring of SOCE for these vehicle classes will be required.

Year or Mileage	Light duty BEVs & PHEVs	Class 2b and 3 BEVs & PHEVs
5 years or 62,000 miles	80% SOCE	N/A
8 years or 100,000 miles	70% SOCE	N/A

The EPA is also proposing new warranty requirements for BEV and PHEV batteries and associated electric powertrain components. For light and medium-duty vehicle classes the proposed warranty period is set at a minimum of **8 years or 80,000 miles**.

Heavy-duty Vehicle Classes

The EPA does not currently propose that heavy-duty BEVs, PHEVs and FCEVs implement a state-of-certified-range (SOCR) monitor but are requesting comment on whether it should require the SOCR monitor defined in GTR No. 22.

For warranties, the EPA proposes that manufacturers identify BEV and FCEV batteries and associated electric powertrain components as component(s) covered under emission-related warranty in the vehicle's application for certification. Those components would be covered by the existing regulations' emissions warranty periods of **5 years or 50,000 miles** for "Light" HDVs and 5 years or 100,000 miles for "Medium" HDVs and "Heavy" HDVs.

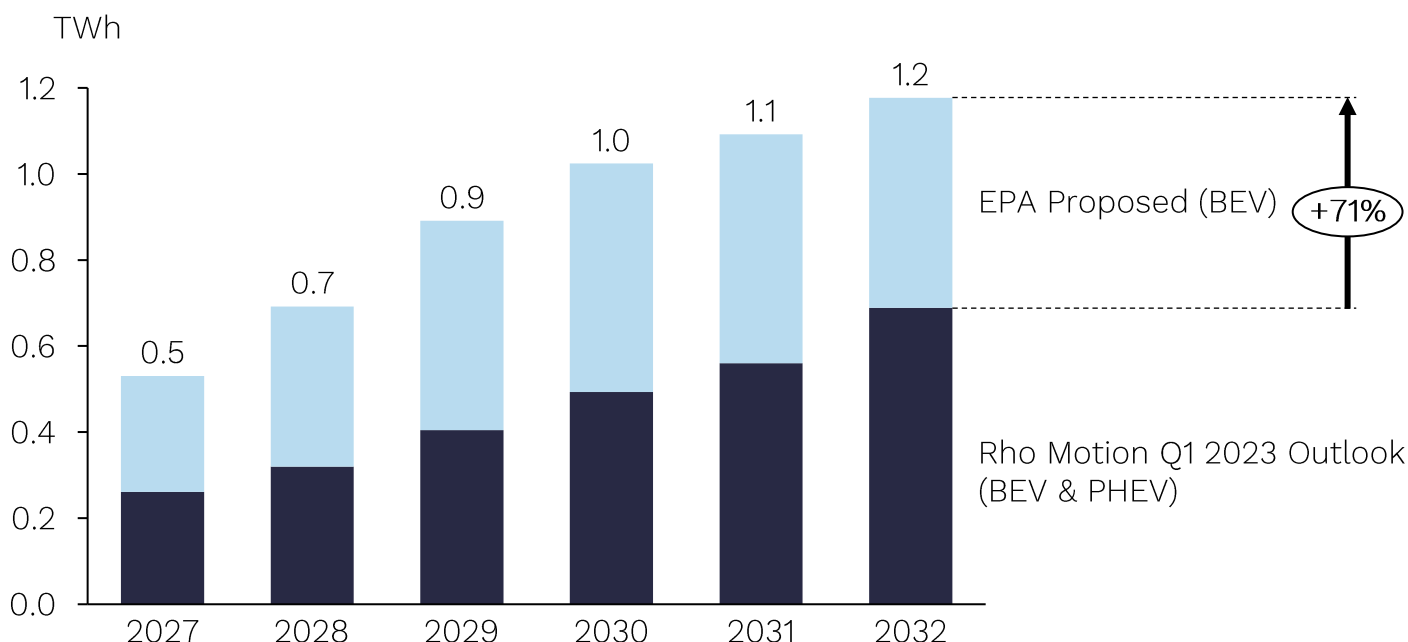


Rho Motion's View

- The new proposal set out by the EPA and discussed in this briefing shows an ambitious pathway for the US to reduce its GHG emissions. The proposed CO₂ emission standards across the different vehicle classes will require OEMs to significantly increase ZEV production in the coming years, a move that will require significant investment from many parts of the EV, battery and charging supply chain.
- In its current form the proposal will have 30 days for comments before further review and its final form is presented, here there is the potential for pushback from OEMs, policy makers and other industry players.
- A common theme through the EPA documents cited as enabling these targets to be set is the Inflation Reduction Act. Furthermore, the influence other regions, particularly Europe, have had on the industry through its regulatory environment is another key enabler of the EPA making these proposals. The fact that OEMs are already preparing to undertake this transition in many major markets gives confidence in their ability to do this in the US as well.
- The quoted BEV penetration rates represent a significant jump up against current expectations for this market and if the final is implemented as currently written it will impact our forecast for the region.

PC & LDV Battery Demand, Rho Motion current, vs new proposed EPA standards

Considering the Q1 2023 Rho Motion EV & Battery Quarterly Outlook battery demand forecast for the US PC & LDV market and the resultant demand the EPA's estimation (note 100% BEV), an additional cumulative 2.7TWh of batteries will be required during this five-year period. In 2032 this translates to an annual demand increase of 71% compared to current Rho forecasts.





Rho Motion's View - Comparison with European Union emissions targets

Comparing the proposed EPA targets to the EU CO₂ emission targets voted into law in February 2023, the US is targeting a less ambitious level of CO₂ reduction across its PC and LDV sales. The EU has a significant head start when compared to the US, with PC & LDV EV penetration reaching 20% and 7% respectively in 2022, it is therefore unsurprising that the US has not set as ambitious targets in the near term.

The targets from the two regions begin to align more closely as we move toward the end of the decade. In 2032 we currently forecast EU, EFTA & UK EV penetration to reach 75%.

CO₂ emission targets EU Commission and EPA Proposed

