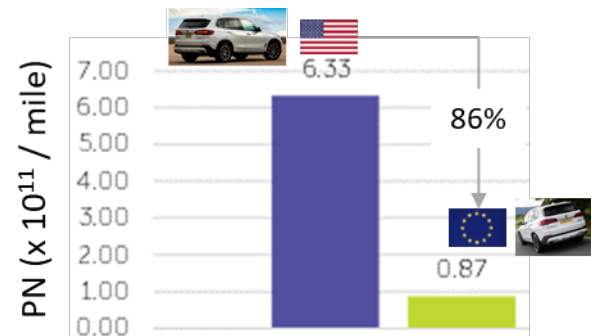


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On road emissions testing done by [Emissions Analytics](#) showed that *same vehicle models* sold in Europe emit 76 - 96% lower particulates compared those sold in the US. The difference is that EU cars were equipped with GPFs, the US weren't due to the lack of particle number or tighter particle mass standards in the US (currently at 3 mg/mi). The reduction in particulate emissions, especially in urban areas, will deliver significant health benefits to all, and as the report highlights, the added GPF content costs less than the optional carpet mats on a car.



Regulatory Update

EPA Clean Trucks Plan

The US EPA has published a proposed [rule](#) for reducing NOx and particulate emissions from heavy-duty engines starting with model year 2027. There are two options proposed:

Option 1 (~ California standards after MY 2031):

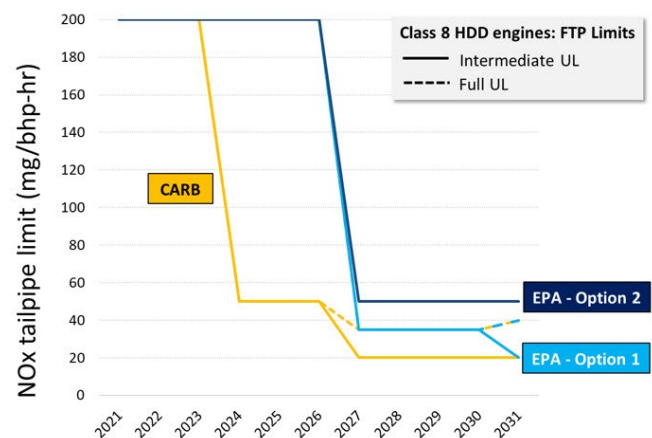
NOx limit

MY2027–2030: 35 mg/mi, MY 2031: 20 mg/bhp-hr

Full Useful Life (FUL): Increases to 600K mi in 2027 and 800,000 mi in 2031

Option 2:

NOx limit: 50 mg/bhp-hr after MY2027, FUL: Fixed at 650,000 mi



A low load certification cycle will be added, and the in-use emissions will be analyzed using the moving average window method (both are similar to California's low NOx regulations). There are credits for early compliance, but no multipliers allowed for HEVs/BEVs/FCEVs

The rule is expected to require advanced engine and after-treatment controls, including technologies such as cylinder deactivation and dual SCR systems.

Also included are targeted reductions to Phase 2 GHG MY2027 – 2029 emission standards for certain vocational segments which are likely to see significant penetration of electrics.

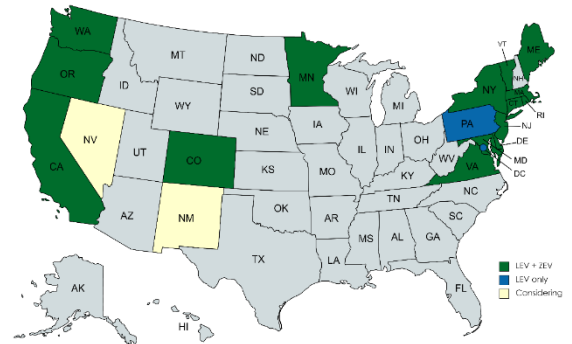
SEC proposes new rule requiring disclosure of GHG emissions

The US Securities and Exchange Commission (SEC) has [proposed](#) a far-reaching rule which will require companies to disclose climate-risk related information in their financial statements. Broadly, companies would require disclosing:

- (a) the governance of climate-related risks and expected material impact on business outlook,
- (b) GHG emissions from direct (Scope 1) and indirect (Scope 2 – think purchased electricity) operations, and
- (c) GHG emissions from upstream and downstream activities in value chain (Scope 3) if these are significant for the business (e.g. oil companies) or if the company has set a target for such emissions.

Delaware to follow California ZEV program

DE is the latest [addition](#) to states that follow California’s ZEV mandates, starting from model year 2027. Minnesota starts in 2024 and counting that and Delaware, there are 15 states which have adopted LEV and ZEV standards. Pennsylvania and DC only follow LEV programs, while Nevada and New Mexico are considering joining these so-called section-177 states.



CARB waiver for Advanced Clean Car Program restored

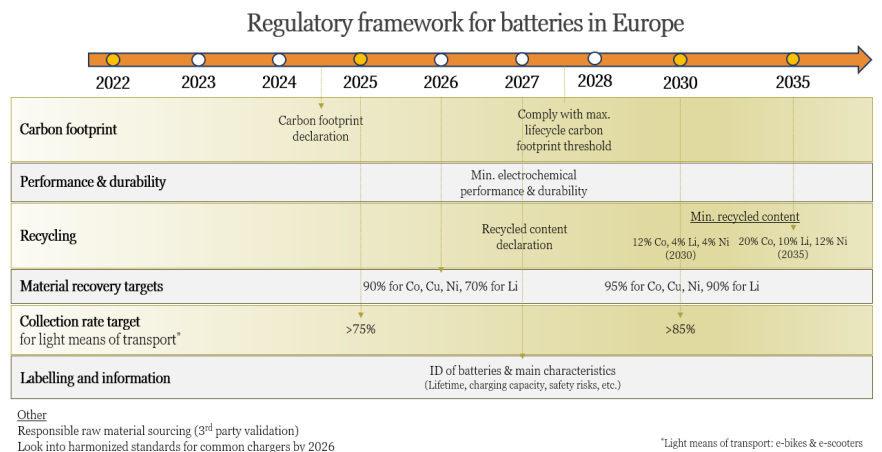
EPA has [reinstated](#) California’s authority under the Clean Air Act to implement its own greenhouse gas (GHG) emission standards and zero emission vehicle (ZEV) sales mandate.

Switzerland adopts new Periodic Technical Inspection (PTI)

Switzerland is the latest country to adopt the NPTI which will require a PN based test for diesel light-duty vehicles for detecting malfunctioning DPFs. This will come into effect starting Jan 1st, 2023. The test requires vehicles to meet a limit of $2.5 \times 10^5 \text{ \#/cm}^3$ at high idle and no load, or $1 \times 10^5 \text{ \#/cm}^3$ at low idle condition. Previously, the Netherlands, Belgium and Germany have adopted the NPTI. In the [Netherlands](#) and Belgium, NPTI starts in July 1st, 2022, while in Germany it also starts Jan 1st, 2023.

European Parliament adopts regulatory framework for batteries

On March 10th, EU Parliament [adopted](#) a draft legislation which revises the previous “Batteries Directive” in 2006 to include batteries for e-mobility and sets targets for carbon footprint disclosures, recovery and recycling, and performance and durability. “Light means of transport” which include e-bikes and e-scooters are also included.



Market Update

Stellantis: Preparing for fuel efficient ICEs and BEVs

As an example of the split approach being pursued by major automakers to meet current ICE and future electrified markets, here are two developments at the same OEM:

- Stellantis [revealed](#) its new 3.0L twin-turbo inline 6-cylinder “Hurricane” engine, which delivers up to 15% lower fuel consumption while delivering > 500 hp in the high output mode (400 hp in standard output mode). The engine features advanced technologies such as twin turbos (each turbo for 3 cylinders), 350 bar injection, diamond-like coating on piston pins to reduce friction, Plasma Transfer Wire Arc (PTWA) coating in the cylinder bores for an ultra-thin, low-friction wear surface, variable compression ratio changing from 9.5 at high-output mode to 10.4 in standard output mode and engine start-stop. The engine meets all emissions requirements of course, but as one article states, “company engineers say there is room for a particulate filter, but it will not be equipped unless it is required”.
- On the heels of their [strategic plan](#) announced recently to sell 50% battery electric vehicles in US and 100% in Europe by 2030, Stellantis has teamed up with LG Energy Solution for a combined investment of \$4B to [establish](#) a 45 GWh Li-ion battery plant in Canada. Production will begin in 2024. The battery capacity translates to a little over half a million BEVs, or 10% of Stellantis’ 2030 target.



Study projects HD electric trucks cost parity with diesels by 2035

According to a [study](#) published by National Renewable Energy Laboratory (NREL), all medium- and heavy-duty ZEVs will reach total-cost-of-driving parity with diesel counterparts by 2035, without any incentives. ZEV sales could potentially reach 42% market share for all MD and HD trucks by 2030. The report found that for distances < 500 miles, BEVs would be cost-competitive, whereas for longer distances, FCEVs would be favored. Buses are assumed to fully transition to ZEVs by 2030. One of the key assumptions in the study is the rapid decline in battery prices.

Is the above possible? Depends on how quickly battery prices decline for HD applications and how quickly charging or H2 refueling infrastructure is established. The oft-cited battery pack price of ~ \$100/kWh applies to LD vehicles. For HD vehicles, packs are much more expensive, close to \$300/kWh in 2020. The study assumes the price declines to ~ \$80/kWh by 2035 and \$50/kWh by 2050. Given the rapid decline in battery prices in light-duty, these targets may very well be achievable. Recently, however, battery prices have gone up in recent months and show that supply chain issues and raw materials could be constraints in the coming decade with increasing share of ZEVs. For fuel cells, the price decline is assumed from ~ \$200/kW in 2020 to \$80/kW by 2035 and \$50/kW by 2050. It remains to be seen whether such steep price reductions could be achieved. Also, whether H₂ makes any sense from a wells-to-wheel GHG reduction perspective is questionable.

Just to put the above in perspective, the latest proposal by the EPA on HD Clean Trucks Plan includes a 1.5% projection of ZEV penetration by model year 2027 nationwide (including California states).

Maersk to deploy 300 electric trucks in N. America between 2023 – 2025

300 Class 8 8TT Gen 3 trucks manufactured by BYD will be [deployed](#) in N. America by “Performance Team”, its warehousing, distribution and transportation business. Maersk is not buying the trucks outright but will be in partnership with Einride, which provides freight mobility and charging solutions. This is perhaps the biggest electric truck order for Class 8 trucks.



To put this in perspective, note that in [Europe](#), 346 electric trucks > 16 tons were registered in 2021. Also, note that this is still a very small fraction compared to the overall market, ~ 150,000 Class 7 and 8 trucks sold annually in the US.

CARB Amendment to Commercial Harbor Craft (CHC) Regulation: Add DPFs and ZEV capability

Next time you take a cruise off the coast of California, better pack a bigger charger. CARB has [updated](#) its Commercial Harbor Craft (CHC) Regulation, with amendments which phase in over 2023 – 2032. The standards are made more stringent and will require majority of regulated in-use and new vessels to meet Tier 3 or Tier 4 non-road standards plus a DPF. The amendments will extend to engines below 50 hp, which were previously excluded. Beyond 2025, short run ferries (traveling less than 3 nautical miles) will have to be zero-emitting by end of 2025. New excursion vehicles are required to be capable of operating with > 30% power from zero-emission tailpipe source, such as through plug-in hybridization.

Technology Update

If you missed the CRC conference and the summary that was sent out earlier, see here for a downloadable copy: <https://mobilitynotes.com/home/tech-updates/summaries-conferences-technical-papers/>

Don't miss these upcoming events ...

SAE World Congress, April 5th – 7th, Detroit and online

<https://www.sae.org/attend/wcx>

43rd International Vienna Motor Symposium, April 27th – 29th, Vienna

<https://wiener-motorensymposium.at/en/>
