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## Market Update

**Passenger cars:** There seem to be two views for electric vehicle sales: one of continued increase in sales, and another of slowing growth in market share. Perhaps both narratives are true, based on the timeframe of analysis.

As reference, Chinese BEV sales increased by 6 percentage points starting from January this year. However, the market share in May 2023 is higher by only 1 percentage point compared to May 2022. In contrast, the year-over-year increase was 12 percentage points from May 2021 – May 2022. China has recently reinstated the EV subsidies and this could provide another boost for EV sales.

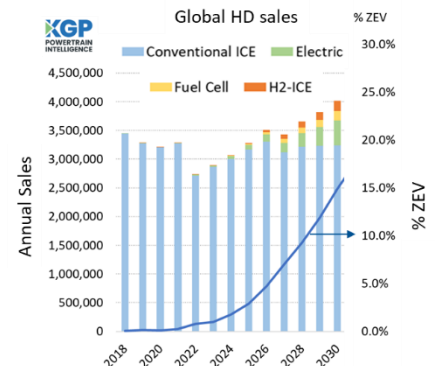
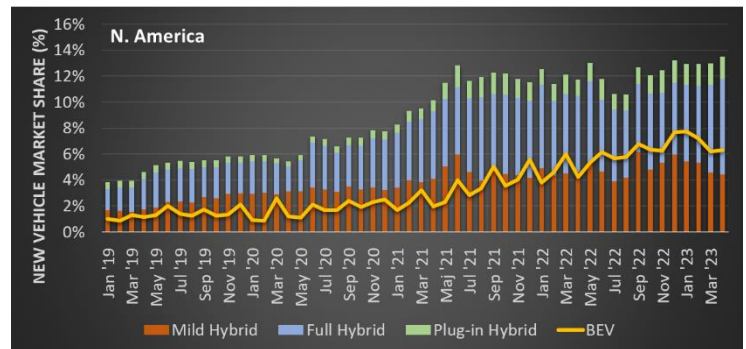
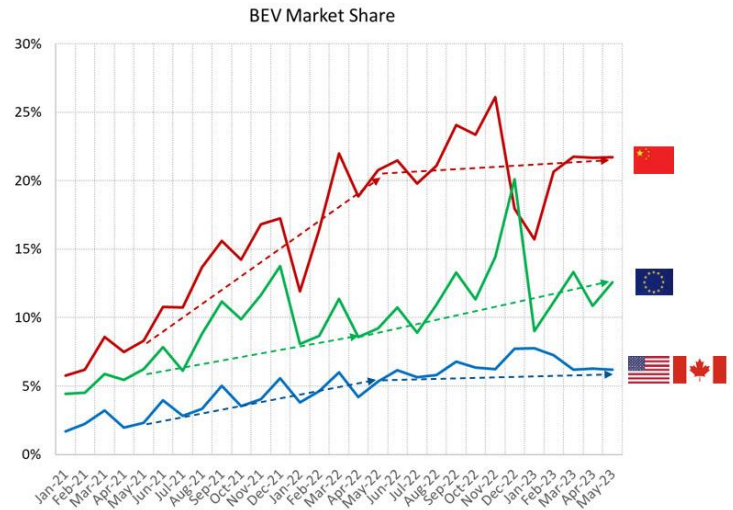
Data source: EV-Volumes

### Hybrids are growing in the US and Europe

Slowly but surely, hybrid vehicle sales have also been increasing in the U.S. In the past two months, full hybrids alone had a higher market share (~ 7%) than battery electric vehicles. Including mild and plug-in hybrids, the year-to-date share of hybrids is now at ~ 13%.

Hybrids are gaining even more popularity in Europe, according to the recent ACEA [report](#). One in three vehicles is now a hybrid (including plug-ins).

**Medium and Heavy-Duty Commercial Trucks:** Globally, the ~ 0.8% of medium and heavy-commercial vehicles sold in 2022 were battery electric, according to [KGP](#). The group projects the share of ZEVs (including fuel cell vehicles) to increase to 15% by 2030. However, total annual vehicle sales are also expected to increase from ~ 3M in 2023-2024 to ~ 4M by 2030, such that conventional ICE vehicles (diesel) continue to grow through the end of this decade.



## Regulations / Reports

### California and U.S. EPA align on Heavy-Duty Low NOx standards

California Air Resources Board announced an agreement with truck and engine manufacturers which provides much needed regulatory certainty and harmonization across the country. Key aspects of the agreement include:

- Broad alignment with U.S. EPA for low NOx limits and in-use compliance requirements starting MY 2027
- Truck manufacturers agree not to pursue litigation on California's authority in courts, and embrace the electrification targets set via the Advanced Clean Trucks and Advanced Clean Fleets rules
- CARB will host workshops in 2023 to discuss the potential role of H<sub>2</sub> ICE towards meeting the ZEV requirements

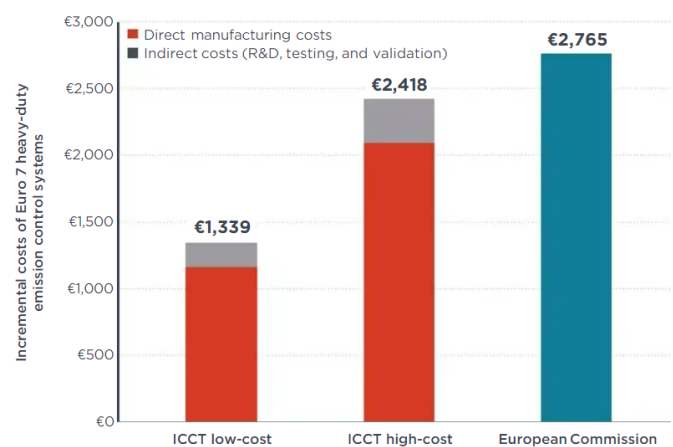
Read more details [here](#).

### ICCT: Euro 7 Heavy-Duty will cost ~ 1-2% of cost of truck

The International Council on Clean Transportation (ICCT) has [published](#) a revised cost estimate for upgrading heavy-duty trucks to meet the proposed Euro 7 standards. The revision was necessary to account for the weakening of the proposal compared to the CLOVE consortium recommendation based on which a previous cost estimate was made.

Euro 7 will require additional SCR content, possibly electric heaters and improved filtration DPFs to meet the low NOx and tighter particulate standards. The revised costs are shown in the figure and range from €1,339 – €2,418 per truck. This is much lower than their previous estimate of €1,400 to €4,300.

In a [previous](#) ICCT publication, the cost of a 2020 diesel tractor-trailer in Europe is estimated at €133,000, so that puts the relative cost of Euro 7 upgrades at ~ 1 - 2% of the cost of a truck.



### European Parliament wants clean air – without much tailpipe improvements

Air pollution is attributed to cause 300,000 premature deaths in the European Union. The European Parliament's Environment Committee voted in favor of a [position](#) for stricter 2030 limits for ambient particulates, NO<sub>2</sub>, SO<sub>2</sub> and ozone.

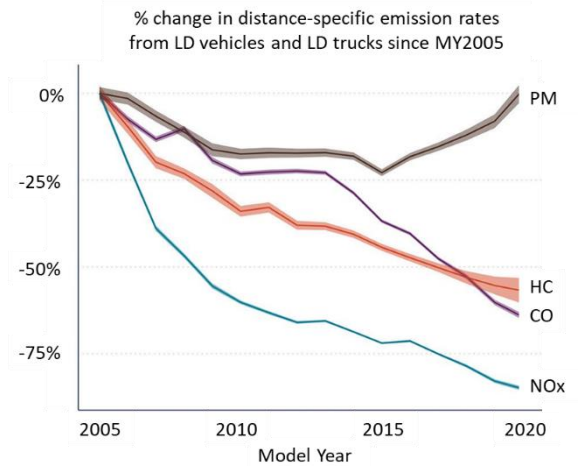
And yet, the Parliament's Committee on the Environment, Public Health and Food Safety has [published](#) their position on the amendments for Euro 7, which propose to significantly weaken the rule. For heavy-duty, the proposal does away with the separate cold, hot and budget requirements, and reverts to the Euro VI-type framework of WHTC and RDE limits, with a conformity factor of 1.5. The document suggests NOx limit to be reduced by 50% only and particle number limit is kept at Euro 6 levels while including particles down to 10 nm (both with CFs of 1.5).

## Impact of particulate standards in the US quantified

Two studies were published – one looking back and another forward – showing the impact of tighter particulate matter standards for light-duty vehicles in the U.S. The EPA has proposed a 0.5 mg/mi standard starting model year 2027. While enforcing the best available technology, the new standard will already be almost a decade behind Europe and China which have required gasoline particulate filters starting Euro 6 / China 6 standards.

The first [study](#) is an analysis of millions of remote sensing measurements done by the International Council on Clean Transportation (ICCT), which shows that while all tailpipe gas phase emissions reduced in the past couple of decades by over 66 - 86%, particulate emissions are still at 2005-levels.

The other study, [published](#) by MECA, quantified the benefits of the tighter MY 2027+ particulate standards through 2050. Three different electrification scenarios show significant benefits of reduced tailpipe PM irrespective of the rate of electrification. The analysis shows that the tighter PM standards would eliminate up to 10 thousand tons/year of black carbon and fine particulates. Cumulatively, the analysis shows 58 to 112 thousand tons of PM2.5 exhaust eliminated, 42 to 81 thousand tons of BC eliminated, and \$18 to \$163 billion of health care cost savings.



## Tracking CO<sub>2</sub> emissions from Heavy-Duty Trucks in Europe

Europe has recently revised the [CO<sub>2</sub> standards](#) for heavy-duty trucks, requiring reductions of 15% by 2025, 45% by 2030, 65% by 2035 and 90% by 2040, relative to a 2019 baseline. Missing these targets carries heavy penalties. The ICCT has [published](#) a report tracking the certified CO<sub>2</sub> values by manufacturers for the model year 2020. Across the industry, CO<sub>2</sub> reduced by 1% compared to 2019, which is slower compared to the required 2.5% each year. These improvements were mostly attributed to improved engines (brake thermal efficiency improved by 0.5%), and lower aerodynamic drag and tire rolling resistance. The share of electrics was miniscule in 2020 but it is clear that it will have to increase to meet the upcoming targets.

## U.S. EPA Final Rule on 2023 – 2025 Renewable Fuel Standard

The U.S. EPA, in coordination with the Departments of Agriculture and Energy, have set the biofuel volume requirements for 2023 – 2025 in its latest final [rule](#). The new requirements will require refiners to blend increasing quantities of renewable fuel, with a net addition of 1.7 billion gallons by 2025, 8% higher compared to 2022. Ethanol blending is kept the same, at 15 billion gallons. Overall, the increase has fallen short of the expectation of biofuel producers and has drawn [criticism](#) from the industry. The consideration of introducing “eRINs” for renewable electricity has been struck down in the current rule.

Volume Targets (billion RINs)<sup>a</sup>

	2023	2024	2025
Cellulosic biofuel	0.84	1.09	1.38
Biomass-based diesel <sup>b</sup>	2.82	3.04	3.35
Advanced biofuel	5.94	6.54	7.33
Renewable fuel	20.94	21.54	22.33
Supplemental standard	0.25	n/a	n/a

<sup>a</sup> One RIN is equivalent to one ethanol-equivalent gallon of renewable fuel.

## Electrification

### China Extends Incentives for New Energy Vehicles (NEVs) through 2027

China had phased out incentives for NEVs in 2022 but faced with a slowing economy, it has [extended](#) the NEV purchase tax reduction and exemption policy until the end of 2027.

- The incentives apply to vehicles priced < 300,000 RMB and is therefore expected to promote electrification of smaller/affordable vehicles.
- The incentives will waive the purchase tax, which is 10% of vehicle price, so capped at 30,000 RMB in 2024-25 and then reduced to half, or up to 15,000 RMB in 2026-27.

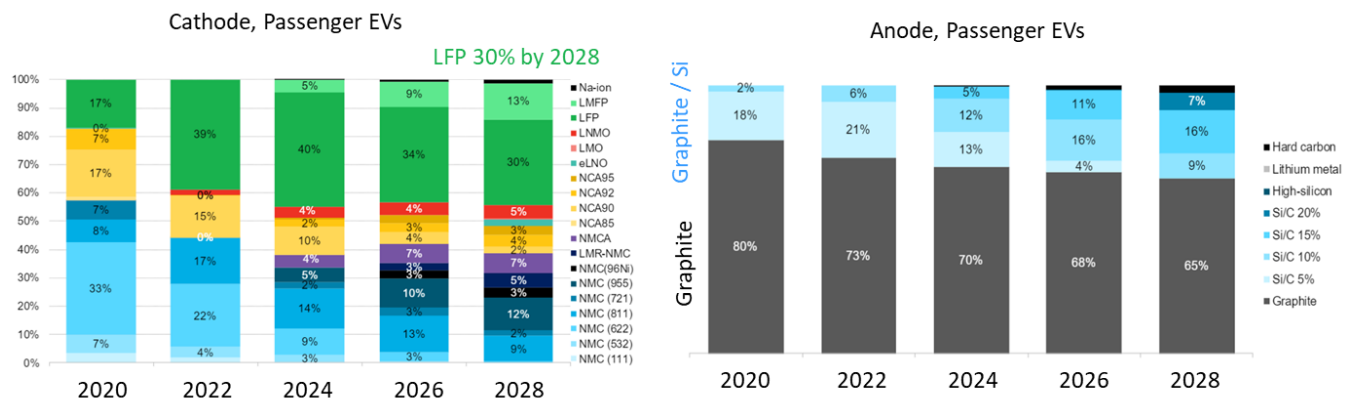
### MAN to start long-haul electric truck production in 2024, targets 50% BEV truck sales by 2030

MAN has [announced](#) that it will begin producing electric long-haul trucks for Europe starting 2024, and that it already has 500 enquiries. It is targeting half of its annual sales to be fully electric by 2030. The trucks have a battery pack of 300 and 500 kWh of usable energy which could meet a wide range of end applications. The trucks will also have megawatt charging capability starting 2025, which will enable 1000 km range with rapid charging during the 45 min breaks allowed in Europe.



### Changing battery chemistries expected to ease some material constraints

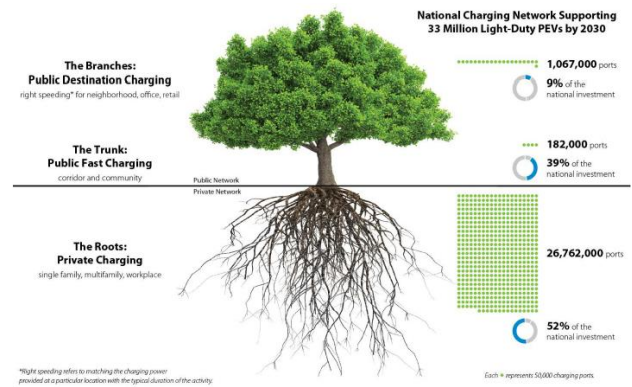
In their latest battery metals outlook, Bloomberg projects that about a third of the electric passenger vehicles will deploy lithium iron phosphate (LFP) batteries. This is expected to ease some of the constraints on Cobalt and Nickel. On the anode side, composite graphite/silicon chemistries are expected to increase share over the years.



The report projects overall battery demand to increase to 2.8 TWh by 2028. This is expected to be met comfortably with the announced battery capacity of 7.4 TWh in 2025, 5 times that of 2022, although not all of that is expected to be available due to lower utilization. China will continue to play a dominant role in battery manufacturing, but its share is expected to drop from 83% today to 72% by 2025.

## Charging infrastructure requirements in the U.S. analyzed

A new analysis [published](#) by NREL estimates that ~ 28 million ports would be required by 2030 to support the mid-adoption scenario of 33 million plug-in vehicles by 2030. These would have to include 1.2M public chargers, of which 182,000 would be fast chargers, and the rest private. Private access charging is clearly expected to be the dominant mode. Cumulative investment for the charging infrastructure is estimated at \$53–\$127-billion.



## Battery swapping for commercial trucks

Charging infrastructure is seen as a key bottleneck for commercial electric trucks. Battery swapping, which has gained market share on the passenger car side in China, is now also gaining momentum for commercial trucks. In a recent [announcement](#), Aulton, a battery swapping company and Foton Daimler have established a partnership to establish battery swapping network for commercial trucks. Aulton's technology is cited to enable swapping within 20 seconds for passenger cars and 40 seconds for commercial vehicles.

## Toyota announces EV strategy

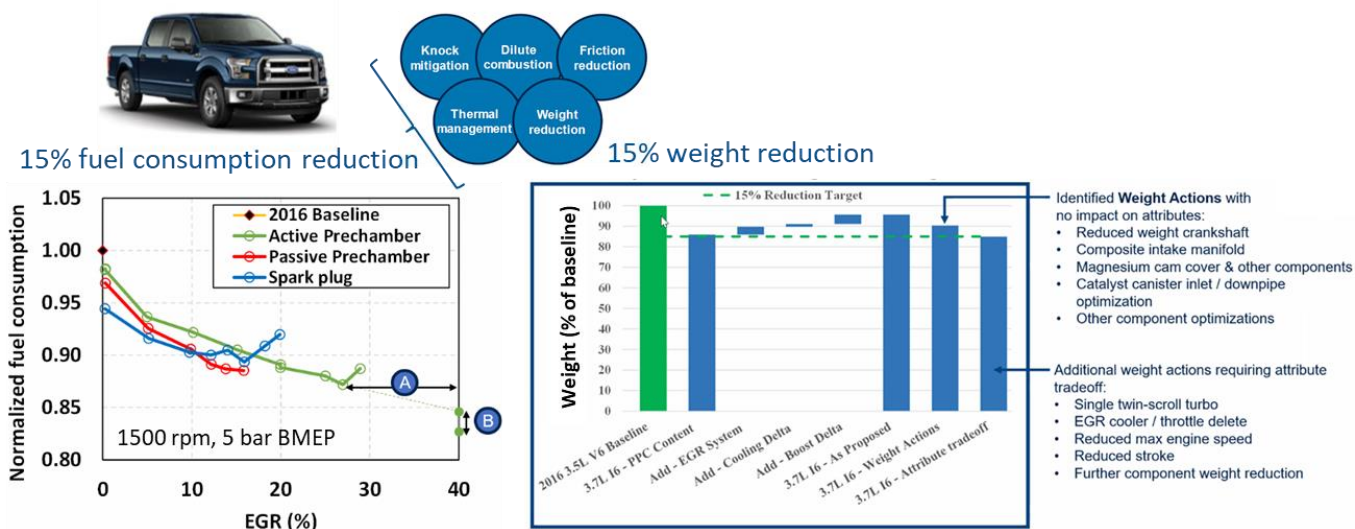
Toyota has [announced](#) that it will target 1.7 million vehicle sales by 2030 to be BEVs. Next generation batteries - solid state to be commercialized by 2027 and introduced in hybrids – are expected to enable vehicles reach 1000 km range. The company will also introduce EVs with LFP battery chemistry by 2026 to reduce production cost.

## Conference Summaries

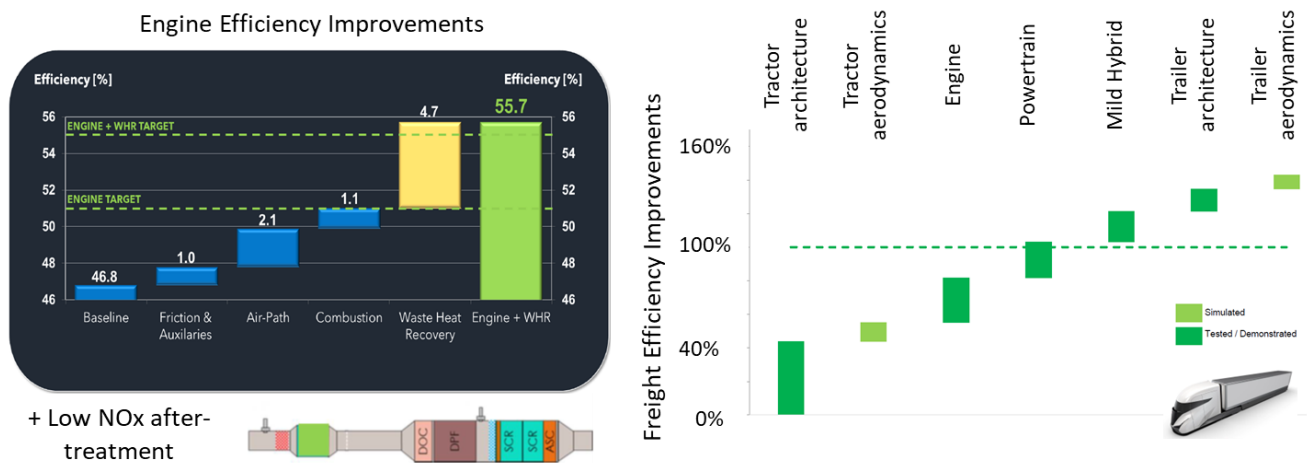
### DOE Annual Merit Review

The U.S. DOE Vehicle Technologies Office held its Annual Merit Review on June 12-15, 2023. Presentations can be found [online](#) for all tracks. It's not possible or intended to provide an entire review here, but here are a couple of examples.

On light-duty, Ford presented a summary of their research aimed at reducing fuel consumption by 23% for a pickup truck with a MY 2016 3.5L V6 Ecoboost engine. Part of the fuel efficiency gains were based on engine improvements – mostly through extended dilute operation through higher compression ratio, pre-chamber and EGR – and weight reduction. The study hints at the limits of fuel efficiency gains that can be obtained without further hybridization.



An example on heavy-duty is the update by PACCAR on the SuperTruck II program, which is in its last year. The team demonstrated 55.7% brake thermal efficiency through combined engine improvements and waste-heat recovery (4.7 percentage point improvement in BTE). Other improvements included 40% increase in powertrain efficiency through mild hybridization, 28% weight reduction, and 63% aerodynamic drag reduction. Combined, these results have resulted in freight efficiency improvements of over 120% (and more to come). Also included was a study of pathway for 2027 Low NOx compliance, including a 48V e-heater and close-coupled SCR.



Other participants in the SuperTruck II program have already successfully concluded their work. Navistar has recently [reported](#) that their ST2 truck with the 55% BTE engine delivers a whopping 16 mpg fuel economy registering a 170% improvement in freight efficiency.

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## Upcoming Conferences

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**SAE On-Board Diagnostics Symposium, September 12<sup>th</sup> – 14<sup>th</sup>, 2023, Indianapolis, USA**

<https://www.sae.org/attend/obd-na/>

**The Battery Show, September 12<sup>th</sup> – 14<sup>th</sup>, 2023, Novi, MI, USA**

<https://www.thebatteryshow.com/en/home.html>

**SAE COMVEC, September 19<sup>h</sup> – 21<sup>st</sup>, Schaumburg, IL**

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

**North American International Powertrain Conference, September 27<sup>th</sup> – 29<sup>th</sup>, Chicago**

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

**Aachen Colloquium on Sustainable Mobility, October 9<sup>th</sup> – 11<sup>th</sup>, Aachen**

<https://www.aachener-kolloquium.de/en/>



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**[EV Volumes.com](#)**

Database of sales statistics, charging infrastructure, batteries, car models, and sales forecasts for plug-in cars

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Innovative Gas Measurement Solutions

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