5-Min Monthly Read - February 2023

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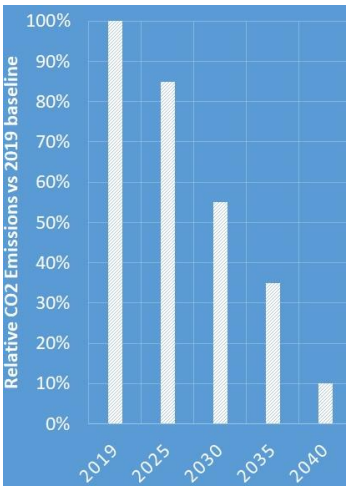
Regulations / Reports

Europe revised CO_2 regulations for heavy-duty vehicles



Europe has proposed revised CO_2 emission standards for heavy-duty vehicle. Previous standards required a reduction of 15% by 2025 and 30% by 2030, for a subset of the vehicle categories. The new standards expand the applicable categories and require deeper reductions. Compared to 2019, the new proposal will require CO_2 emissions reduction of 15% by 2025, 45% by 2030, 65% by 2035, and 90% by 2040.

Other noteworthy changes:

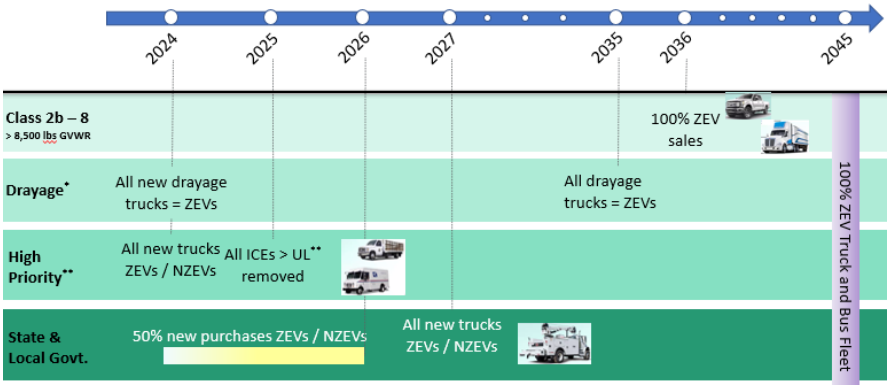
- Definition of zero-emitting vehicle – ZEV – changed to vehicle with: "< 5 g/(t·km) or 5 g/(p·km) of CO2 emissions" from the previous cut-off of 1 g/t.km cut-off. This likely qualifies H_2 ICEs to be deemed as ZEVs.
- All urban buses must be ZEVs by 2030.
- No incentives for use of low carbon fuels (they are addressed using other tools such as Renewable Energy Directive)

ZEV impact: In the impact assessment, the EU Commission estimates the ZEV share required to meet these targets at 20-35% by 2030, 35-57 by 2035 and 57-100 by 2040. In the report last month, we have covered a study by the ICCT which predicts ZEV shares of 58% for 60% CO_2 reduction and 88% for 90% CO_2 reduction.

Read here for an extended summary.

California Advanced Clean Fleets – 100% ZEV target date pulled forward by 4 years

In a recent workshop, California's Air Resource Board (CARB) outlined their target of all new Class 2b – 8 trucks sold in California to be ZEVs by 2036, which is 4 years earlier than was previously proposed. Existing ICE-powered trucks will be phased out, and fleets expected to be 100% ZEVs by 2045. Legacy trucks can operate till their end of life, defines as 800,000 miles or 18 years for tractors.



Read here for an extended summary.

Panel highlights need to pursue all options for heavy-duty decarbonization

A panel discussion at the Technology & Maintenance Council's Annual Meeting highlighted the need to continue working on all technologies. A very handsome speaker – yours truly – highlighted that modern diesel trucks today are two orders of magnitude cleaner than ones since regulations started in the 80's. Moreover, fleet operator Schneider gave real-world experience with operating Class 8 electric trucks: A demonstration project cost $27M for deploying 50 battery electric

trucks ($19M for trucks alone), and in one region it has taken over 2.5 years to make the necessary upstream electricity upgrades to provide 4.8 MW power for charging trucks. The underlying message was that for heavy-duty trucks, infrastructure needs to be developed before considering other hurdles.

Read *here* for a summary from Trucknews.com of the panel, describing steps being taken at Pepsi and Schneider for fleet decarbonization

Germany threatening to block European 2035 ICE ban

The European Parliament approved the effective ban on internal combustion engines after 2035. This will require the final approval from member states, expected to be done in March. But now Germany and Italy are opposing the ban and threatening to veto it unless ICEs running on synthetic fuels are allowed post-2035. Some other countries such as Poland and Hungary are also opposed to this ban.

New Jersey targets 100% clean energy and ZEVs by 2035

NJ Governor Murphy announced adoption of an executive order which will target 100% of electricity sold in the state to come from clean sources starting 2035. A stakeholder process will be initiated to consider adopting Advanced Clean Cars II and 100% light-duty vehicle sales to be ZEVs by 2035.

Electrification

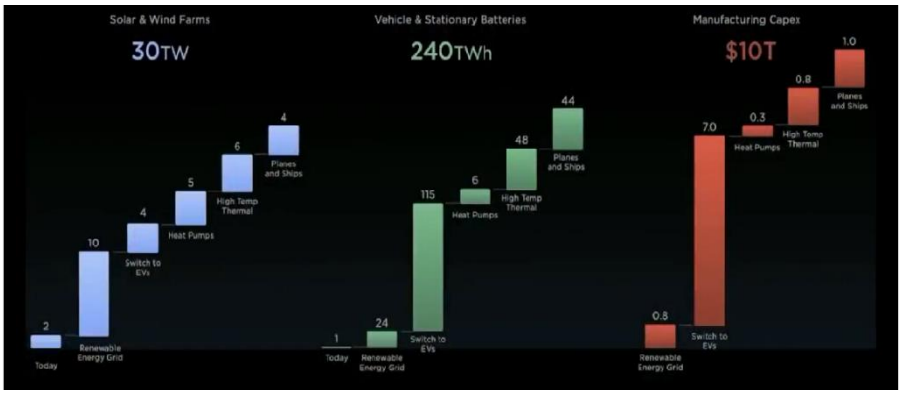
OEM actions

GM continues to foray into battery raw material mining

In October last year, GM invested $69M in an Australian producer of nickel and cobalt. In January this year, it paid $650 million for a stake in Lithium Americas to develop a mine in Nevada. In February, it is competing for a stake in Vale's base metals unit to get access to Brazilian copper and nickel resource.

Tesla investor day

An electrified future – 30TW renewable, 240 TWh storage, "only" $10T cost



- An all-electric future will require 30 TW of renewable power and 8 hours of storage resulting in 240 TWh battery storage capacity $10T manufacturing investment.
  Here's a good article which goes deeper into the material implications - 240 TWh of Li-ion cells *"would mean a total requirement of c.160Mt of lithium carbonate equivalent (LCE). Given that current production is of the order of 0.7-0.8Mtpa of LCE, you can understand the magnitude of the bottleneck"*
- Move to electric vehicles associated with 21% reduced fossil fuel. Further reductions will require shift to renewables, heat pumps, electrifying high temperature applications, use of hydrogen and sustainable fuels for planes and boats.
- Mining *reduced* from today's 68Gtons to 54 Gtons

Specific to Tesla EVs -

- Long-term ambition to sell 20 million vehicles per year (last year it sold 1.3M vehicles)

- Tesla cars are facing price elasticity – even small changes in vehicle price is leading to large changes in demand – implying that consumers are indeed looking for lower priced EVs.
- The next gen vehicle is expected to have 50% reduced cost, coming from vehicle, battery and process improvements. Process improvements will lead to next gen vehicles with 40% lower manufacturing footprint.
- Next gen permanent magnet motors will not require any rare earth metals.
- New 50 GWh lithium refining plant in Texas operational by end of 2023, next auto plant in Mexico.
- Tesla is far ahead of competitors for the use of real-world AI (artificial intelligence) for production, and this is "the least appreciated part of what we are doing at Tesla" and "worth more than the car side of things long-term"

Toyota "EV-first-mind-set"

Toyota's new CEO Mr. Sato announced an "EV-first mind-set", while also underscoring the company's continued approach on advancing all powertrain options. Lexus will lead this strategy, which will extend to other vehicles. More details are expected when the new CEO officially takes over in April.

U.S. announces new standards for electric vehicle chargers

The Biden administration announced new investment to spur domestic manufacturing and deployment of chargers and hydrogen refueling infrastructure in the U.S. This includes $5B on EV chargers along major highways, "Made in America" provisions which will require > 55% of cost of all components must be manufactured in the U.S. by July 2024 for funding through Bipartisan Infrastructure Law, and $2.5 billion from the Federal Highway Administration (FHWA), to be spent over five years to deploy public charging and alternative fueling infrastructure.

The U.S. government targets 500,000 EV chargers to be deployed by 2030. To put that in context, China built 650,000 public chargers last year alone, and has 383,000 chargers in a single province of Guangdong.

Batteries

NY-based battery recycling

The US Energy Department has approved a $375 million loan to Li-Cycle Holdings for the expansion of a facility in Rochester, NY for recycling Li-ion batteries. This is expected to produce enough material for > 200,000 electric vehicles a year.

EV demonstration with Na-ion batteries

Chinese OEM JAC along with HiNa Battery Technologies unveiled a demonstration car powered by sodium-ion batteries and with a range of 250 km (155 miles). As this article points out, Na-ion batteries are cheaper and considered to be a safer alternative but have a lower energy density of 70 – 160 Wh/kg compared to 275 Wh/kg for Li-NMC.

This paper by Nobel laureate John B. Goodenough and colleagues is credited with sparking interest in Na-ion batteries.

Engines and Fuels

JCB H_2 ICE for construction equipment

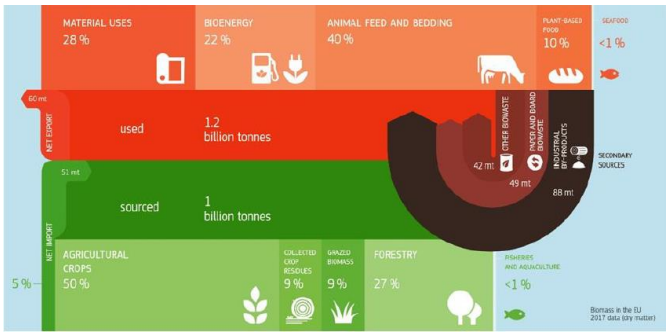
JCB, the British agriculture and construction equipment manufacturer has been working on H_2-combustion engines and has unveiled a 4.8L H_2 ICE for a backhoe loader. The company has found H_2-ICE to be a lower cost pathway relative to fuel-cells. Many of the parts of a base diesel engine are retained leading to low cost. Modifications made include a new cylinder head, new turbocharger, new piston bowl design, H2 injectors and spark plugs – basically all aspects for better H_2-air mixing for lean operation and ignition. Here's a video which shows the equipment in action.

Aramco to join Geely and Renault Group's new powertrain company

Aramco signed a letter of intent to join Geely and Renault in their new powertrain technology company, which is expected to deliver over 5 million ICE and hybrids per year. Aramco's investment will support synthetic fuels and next-gen hydrogen technologies.

Biomass production and use in the European Union

A report from the Joint Research Center at the EU Commission provides an overview of the production, supply chain and end use of biomass in Europe, based on 2017 data. About 70% of biomass is derived from agricultural crops. In terms of end-use, 22% is used in biorefineries for making all kinds of products – of which 25% is used to produce biomethane and liquid biofuels.



Upcoming Conferences

On-Board Diagnostics Symposium-Europe, March 14th – 16th, 2023, Prague, Czech Republic
https://www.sae.org/attend/obd-europe

40th International Battery Seminar, March 20th – 23rd, Orlando, Florida
https://www.internationalbatteryseminar.com/

33rd CRC Real World Emissions Workshop, March 26th – 29th, Long Beach, California
https://crcao.org/33rd-crc-real-world-emissions-workshop/

2023 Onboard Sensing, Analysis, and Reporting (OSAR) Conference, March 30th – 31st, Riverside, California
https://www.cert.ucr.edu/osar

Thanks to the following for their generous support of this newsletter:

EV Volumes.com

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

Sensors Inc.

Innovative Gas Measurement Solutions

Emissions Analytics

Leading independent global testing and data specialist for the scientific measurement of real-world emissions

Diesel Technology Forum

Learn more about advanced diesel technology and how, where, and why it fits into the future