5-Min Monthly Read

December 2021

+ Upcoming events listed at the end

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Happy Holidays and wish you a great 2022 ahead!

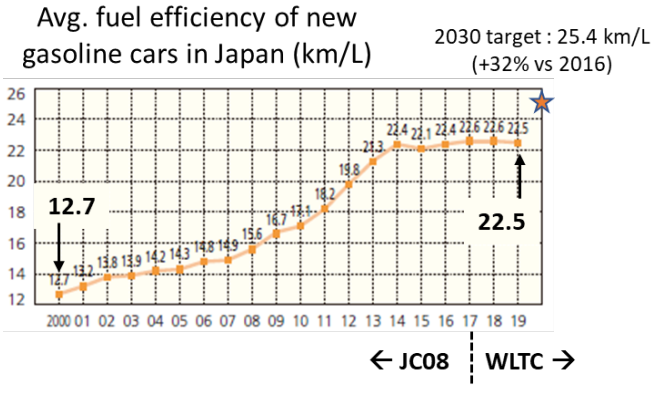
Market Update

BASF

Starting January 2022, BASF will separate its mobile emissions catalysts business and form a new entity named BASF Automotive Catalysts and Recycling. The company will increase its focus on cathode active materials.

JAMA report

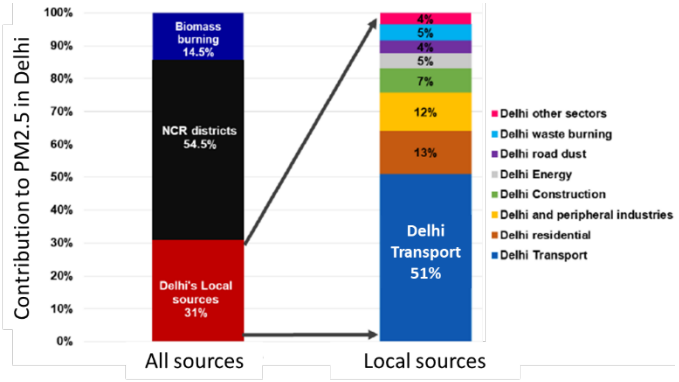
The Japanese Automobile Manufacturers Association has published its annual report on the motor industry. The report mentions Japan's target to reach carbon neutrality by 2050 and automakers taking steps to achieve 100% new "electrified" vehicles sales by 2035.



The transportation sector contributes ~ 1/5th of total CO_2 emissions in Japan (~ half of this of this from passenger cars and one third from trucks). Compared to 2018, GHG emissions need to reduce by a third by 2030, but the improvements seem to have hit a plateau in the past few years. Hybrids have a ~ 35% market share of new registrations, but that seems to also have hit a plateau in the past few years. Pure EV sales are still very low, below half a percent.

Delhi air pollution

In what appears to be a recurring situation, Delhi (India) again suffered severe pollution levels in November, causing schools to closed, construction to be banned and 6 of the 11 coal fired plants to be shut down. A study by the Centre for Science and Environment (CSE) in India has analyzed real time data covering contributions from transport, industry, construction, waste burning, energy, residential sources, road dust and

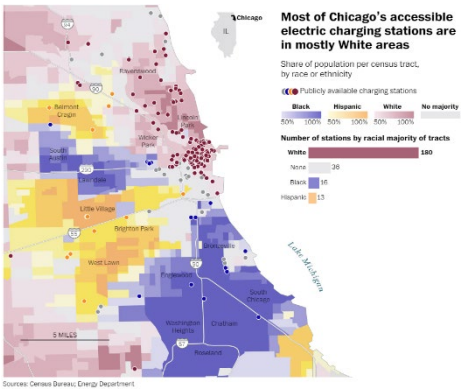


others. It concluded that vehicular emissions contributed to more than 50% of the emissions occurring from local sources. https://www.cseindia.org/vehicles-the-biggest-contributors-to-winter-pollution-in-delhi-cse-11048

India's BS6 regulations will require particulate filters for diesels, but do not apply to port-fuel injected gasoline vehicles, a majority of the fleet today.

The only thing worse than Delhi's outdoor pollution is the indoor pollution. Another study by the Energy Policy Institute at the University of Chicago (EPIC India) found that indoor PM2.5 levels during the winter were 23 – 29 times the WHO safe level of 10 $\mu g/m^3$. In perhaps a perverse case of environmental justice, the study found that the pollution levels were only 10% better for affluent homes with air purification systems and that neither rich nor poor get to breathe clean air in Delhi.

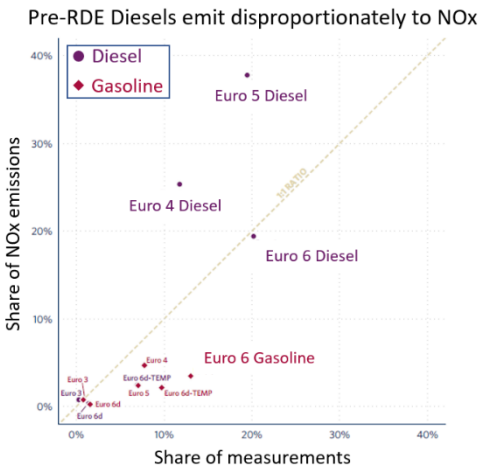
Lest it is concluded that rapid electrification will bring immediate relief to the Delhi pollution, it is worth pointing out that full electrification will take time, India's electricity is still reliant on coal (note that Delhi has 11 coal fired plants) benefits of electrification are not high today, and that making charging stations available to people from all walks of life is not an easy policy decision. As an example from the US, an article in the Washington Post points out that electric charging stations are mostly being deployed in White neighborhoods, leaving behind Black and Brown communities behind in the transition to electrics.

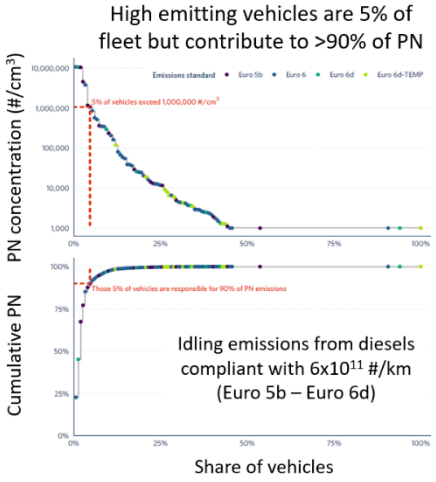


Technology Update

Fleet measurements in Brussels – 90% emissions from 5% high emitters

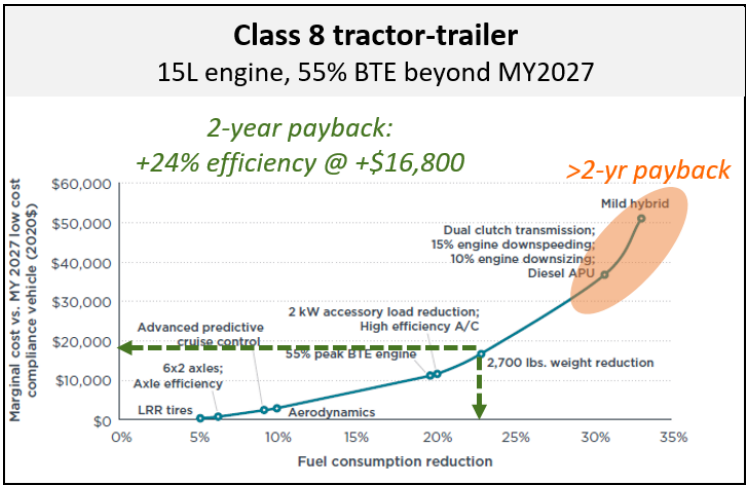
A report from the International Council on Clean Transportation (ICCT) shows that Euro 6d regulations have significantly reduced tailpipe emissions on road, but legacy fleet and high emitters contribute disproportionately to NOx and particulates. Emissions from over 130,000 vehicles in Brussels were measured using remote sensing. It was found that Euro 6d diesels subject to RDE testing are emitting up to 74% lower NOx compared to previous Euro 6 standards. However, Euro 4 vehicles, which accounted for 12% of the vehicles measured, contributed 26% of the total NOx and 47% of PM. Similarly, on gasoline vehicles subject to RDE standards were found to emit 6 times lower PN compared to previous Euro 6 standards, presumably due to application of GPFs on direct injected vehicles. Only 5% of the Euro 5b and Euro 6 compliant fleet was found to exceed 10^6 particles/cm^3 (a threshold indicative of DPF failure or tampering), however these 5% vehicles were contributing > 90% of total particles emitted. The study highlights that with the cleaner Euro 6d vehicles, most emissions are occurring from older vehicles or with malfunctioning emission control systems.





CO_2 reduction from HD trucks - Diesel

A report by the ICCT shows that CO2 emissions from HD trucks – both line hauls and vocational – could reduce by a third, beyond the already lowered (by 16 – 24%) emissions following model year 2027 GHG Phase 2 standards.



Improvements considered for Class 8 include 55% BTE engine (demonstrated under the DOE SuperTruck II program), 10% engine downsizing, 23% lower rolling resistance vs. 2027 tractor-trailer standards, advanced aerodynamics, net weight reduction of 2,700 pounds, predictive cruise control, the use of 48V e-accessories and mild hybridization with a 10-kWh battery.

Compared to model year 2027, the analysis showed further reduction of fuel consumption by 33% at a marginal cost of $53,000. Mild hybridization was found to be the least cost-effective, with an average payback period of 4.5 years. Assuming only technologies with a 2-year payback, 24% efficiency improvement was projected for additional $16,800. That's a ~13% increase in the cost of a new sleeper truck (today). For vocational vehicles, a 34% decrease in CO2 emissions was projected with an added cost of $17,400. And this does include mild hybridization, as its more cost effective given the transient driving pattern.

CO_2 reduction from HD trucks – H_2/CNG

Most CNG trucks are operated using stoichiometric engines (the lean burn CNG require more complex after-treatment). A new report from Concawe reviewed the benefits and challenges of adding H_2 to stoichiometric CNG engines for HD vehicles. H_2 addition to natural gas lowers CO_2 production per unit energy, reduces methane slip and can potentially increase engine efficiency up to 13%. For 20% addition of H_2 in CH4, the GHG emissions could be reduced by 8 – 20% depending on the improvement in engine efficiency. Also, the presence of H_2 increases the lean flammability limit and allows for a higher EGR ratio resulting in lower NOx emissions. However, given the lower density, a mixture with 20% H_2 will also result in reduced driving range of 14 - 24% (again depending on engine efficiency). H_2 addition also results in increased knocking tendency and water content in the exhaust and could potentially form higher NH_3 and N_2O on the three-way catalyst, all factors which needs to be studied in more detail. The report points out that adding H_2 beyond a certain range will require improving tolerance of fuel line components, tanks and other equipment. Currently there is a limit on the H_2 addition allowed in the natural gas supply in Europe, highest at 5% in Spain.

Electric HD trucks in Europe: TCO parity sometime this decade projected

In another study focused on Europe, the ICCT analyzed trucks with 500 km range without recharging, which covers about 70% of the daily trips. A 25% reduction in fuel consumption was assumed for diesel engines through this decade at an incremental cost of €12,000. Over the same period, battery electric trucks are assumed to improve in efficiency by 28% while also enjoying a price reduction of over €250,000 due to battery price decline from €250/kWh in 2020 to ~ €80/kWh in 2030. Other assumptions include a 27% reduction in reduced battery capacity (930 to 675 kWh) for the 500 km range by 2030, a 30% lower maintenance cost for BEVs, overnight charging at 100 kW followed by one charging stop of 45 mins at 350 kW and a ~60% reduction in electricity price for charging by 2030.

The analysis found that without any additional incentives, total cost of ownership (TCO) parity between BEVs and diesels is reached in the 2024 – 2029 timeframe for various countries considered. Various policy measures such as purchase incentives and road tolls for diesels were evaluated and showed that the time to cost parity could be significantly accelerated.

LCA symposium

Presentations from the recent symposium on life cycle analyses, hosted by Southwest Research Institute (SWRI), are available for free download.

Regulatory Update

CARB HD I/M

California Air Resources Board (CARB) approved the HD Inspection & Maintenance (I/M) program, designed to ensure that emission control systems of HD vehicles driven in California maintain their performance with vehicle aging and are repaired if malfunctioning. The regulation applies to all non-gasoline vehicles with GVWR > 14,000 lbs. and require twice-a-year inspection and data submission to CARB. Compliance could be demonstrated using OBD (and conveying information remotely via telematics technology), smoke opacity tests and visual emissions control inspections for non-OBD vehicles. A statewide network of roadside emission monitors devices will also be installed to screen high emitters. The initial compliance requirements begin in 2023 and periodic testing starts in 2024.

China non-road stage IV

Beijing implemented the Chinese non-road stage IV regulations one year ahead of schedule, starting December 1st, 2021. The regulations set emission limits equivalent to Euro Stage IIIB, but also add a DPF enforcing PN limit of $5x10^{12}$ #/kWh for 37-560 kW engines. PEMS based in-use compliance testing is required for machines > 37 kW. Also introduced is a requirement for adding GPS and telematics for data transmission to authorities, also for engines > 37 kW.

Don't miss these upcoming events in 2022 …

SAE Govt. Industry Meeting, Jan 18th – 22nd, Washington DC and online
https://www.sae.org/attend/government-industry/

31st CRC Real World Emissions Workshop, March 13th – 17th, San Diego, California
https://crcao.org/2022-31st-crc-real-world-emissions-workshop/

11th Annual PEMS Conference, March 17th – 18th, Riverside, California
https://www.cert.ucr.edu/pems

SAE On-Board Diagnostics Digital Summit – Europe, March 15th – 17th, online
https://www.sae.org/attend/obd-europe

SAE World Congress, April 5th – 7th, Detroit and online
https://www.sae.org/attend/wcx
