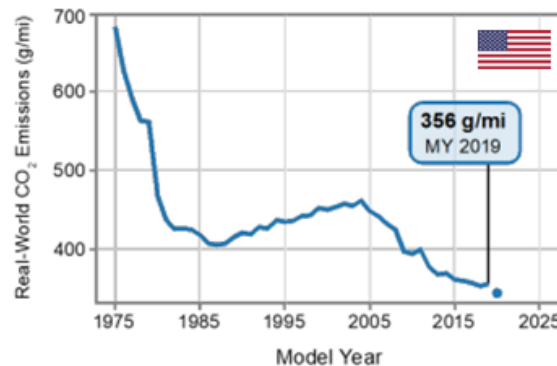
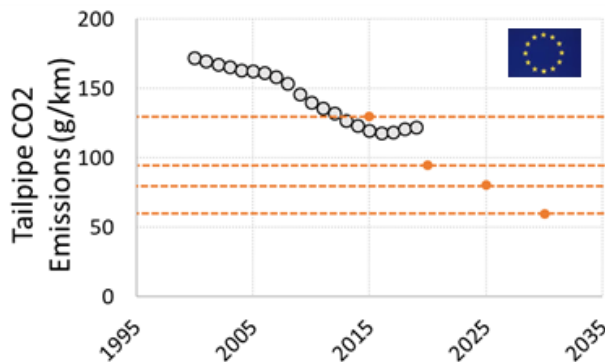




Regulations

- In 2019, the average real-world CO₂ emissions for new vehicles increased in both the US and Europe.



- In Europe, VW is expected to pay a fine of ~ €150M for missing the 2020 target despite an increase in battery electric vehicle sales.
<https://amp.ft.com/content/22514024-554b-482b-bc4f-25557ab0571d>
- In the US, increased by 3 g/mi to 356 g/mi compared to the previous year. Partly, this is driven by the consumer preference for larger vehicles: ~ 2/3rd of the vehicles sold were SUVs/pickup trucks/minivans.
- US GDI share (relevant to GPFs) is expected to be 55% for 2020.
<https://www.epa.gov/sites/production/files/2021-01/documents/420r21003.pdf>
- The Biden administration has taken several steps in the first few days in office to reassert US leadership on climate change.
 - The US will rejoin the Paris Agreement and commit to 100% clean energy goal by 2050.
 - Fuel economy standards set by the previous administration for MY 2021 – 2026 will be reviewed. Standards for model year 2026 and beyond to be proposed.
 - Ozone and particulate matter air quality standards, frozen under the previous administration, will be reviewed.
 - It is expected that the court case against California's waiver to set its own stringent standards will likely be dropped.

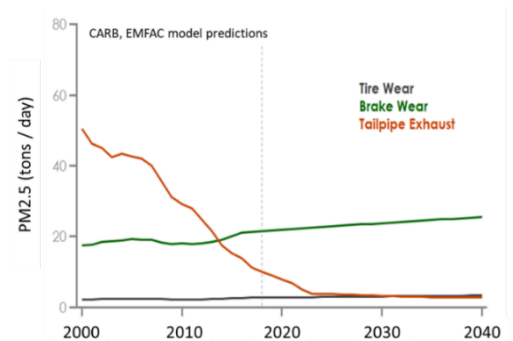
Agencies are being directed to make decisions guided by the best available science and data.

- At the SAE Government Industry meeting, EPA reiterated that they are working on closely aligning the heavy-duty Cleaner Trucks Initiative regulation with California's Low NO_x Omnibus by 2027. The latter requires a 90% reduction in tailpipe NO_x and 50% reduction in PM by 2027 along with an increase in useful life and warranty.

- European Commission member states have agreed on > 55% greenhouse gas reductions by 2030 compared to 1990 levels. This will be translated into revised CO₂ standards later this year, which currently required a 37.5% reduction in tailpipe CO₂ by 2030 compared to 2020. Also included is a target of 30 million zero emitting vehicles by 2030.
- China's non-road stage IV regulations are published. The regulations apply to engines ≤ 560 kW starting Dec 1st, 2022. For 37 – 560 kW engines, a DPF enforcing PN limit of 5x10¹² #/kWh is introduced, as is the requirement for GPS and OBD transmission. For gas emissions, PEMS will also be used for in-use compliance, with not-to-exceed requirements of 2 times the cycle limits.

http://www.mee.gov.cn/xgk2018/xgk/xgk01/202012/t20201231_815661.html
http://www.mee.gov.cn/xgk2018/xgk/xgk01/202012/t20201231_815612.html

- In response to Covid, the government of Thailand has postponed the introduction of Euro 5/V and Euro 6/VI standards to 2024 and 2026, respectively.
- Netherlands has formally adopted the New Periodic Technical Inspection (NPTI) regulation to detect malfunction or tampering of DPFs. The regulation applies to all Euro 5+ light-duty vehicles and Euro VI commercial trucks starting 1st July 2022. It involves a quick particle number test at hot idling, previously been correlated with real-world driving emissions. Other countries in Europe are expected to adopt this, notably Germany and Belgium.
- The UNECE hosted a workshop on particulate emissions related to brakes and tires. Projections by CARB (California) and JRC (Europe) show that non-exhaust emissions are expected to exceed those from tailpipes. A test cycle has been identified for brake emissions and a proposal is being evaluated to use this for regulations. This is still in the early stages, more work has to be done.



<https://wiki.unece.org/display/trans/PMP+Workshop+on+Brake+Emissions++Regulation>

Technology

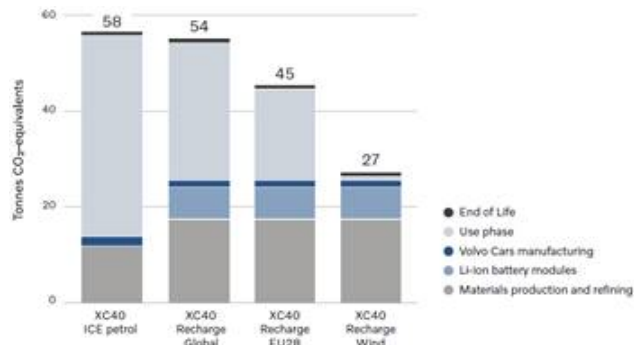
- Achates Power has demonstrated NOx emissions below the California Low NOx regulation of 0.02 g/bhp-hr using its 10.6L opposed piston diesel engine technology. Notably, this was done using a conventional after-treatment system. Furthermore, the CO₂ emissions are also below the 2027 GHG requirements.

<https://www.truckinginfo.com/10132793/opposed-piston-engine-achieves-significant-emissions-milestone-for-commercial-ve>

- Cummins has implemented the first dual dosing urea injection system for heavy-duty trucks starting with the Scania V8 770 bhp engines. Dual dosing helps optimize ammonia for each of the SCR unit and is seen as a key enabler for future low NOx systems, especially utilizing close-coupled SCR. Cummins also expects this to deliver 2 – 3% fuel efficiency improvements.

<http://www.transportengineer.org.uk/transport-engineer-news/cummins-brings-first-dual-dosing-urea-injection-system-to-market-for-scania-v8/233557/>

- Volvo published a study comparing the overall of their XC40 models – one an ICE and another Base on the electricity source, they show that:
 - The EV emits almost the same CO₂ as the global electricity mix, and emits ~ 50% when using completely renewable
 - Since the EV has a higher manufacturing it has to be driven for ~ 150,000 km starts delivering any CO₂ reduction.



CO₂ footprint an electric.

ICE based on lower CO₂ electricity. CO₂ footprint, before it

<https://group.volvocars.com/news/sustainability/2020/transparency-around-electrification>

- A recent publication from MIT considers the use of SCR technology for reducing NO_x emissions from aircrafts. The paper concludes that it's a possibility for smaller engines, although the form factor is a very large and thin pancake to accommodate a very low pressure drop. Modeling results show a > 95% NO_x conversion possible with a 0.5% fuel penalty.

<https://pubs.rsc.org/en/content/articlelanding/2021/EE/DOEE02362K#divAbstract>

Electrification / Non-conventional fuels / Other

- In 2020, ~ 3.2 million plug-in electric vehicles (EV + PHEV) were sold globally.
 - In Europe, tough CO₂ targets, increased availability of EV models and incentives increased sales of electrified vehicles. It outpaced China as the largest market for electric and hybrid vehicles. A total of 1.4 million plug-in electric vehicles were sold through the year, representing a market share > 10%. Of these, ~ 730,000 were pure electric.
 - In the US, BEV share grew by 14%, while hybrids share increased by 25%. Total electrified vehicles (hybrids + EVs) accounted for ~ 5% of the market share in the US.

<https://www.iea.org/commentaries/how-global-electric-car-sales-defied-covid-19-in-2020>

- General Motors has announced that it aspires to sell only zero-emitting vehicles beyond 2035 and to power all operations using renewable electricity and reach net zero carbon emissions by 2040. GM will invest \$27 billion over the next five years into electrification and autonomous technologies. It expects to offer 30 all-electric models worldwide by 2025.

<https://www.reuters.com/article/us-gm-emissions-idUSKBN29X2AY>

- Japan is targeting phase out of pure ICE powered vehicles by 2035, after which the vehicles will be either hybrids or zero emitting.
- S. Korea has adopted California-style ZEV regulations, requiring 22% credits by 2025. Credits are calculated based on characteristics such as the all-electric driving range. Currently these requirements are voluntary, but automakers will be fined for non-compliance after 2023. The government is targeting 1.13M BEVs and 200,000 fuel cell vehicles by 2025.