Analysis of European Vehicle Technology Development Based on the A3PS Roadmaps and Presentations at the Eco-Mobility Conferences

Main Findings

- Battery and hybrid electric powertrains were early on considered and have gained a significant market share among new vehicle registrations.
- Fuel cell electric vehicles were elaborated extensively in the roadmaps but a real market introduction did not take place.
- All roadmaps have correctly predicted the dominance of the internal combustion engine.
- The importance of renewable fuels to reduce CO_2 emissions has been highlighted.
- Regarding biofuels only FAME, bioethanol and HVO are used on a commercial scale in road transport.
- Both ERTRAC and the A3PS reach comparable conclusions in their roadmaps.

Political Influence

- The Renewable Energy Directive II is considered as a key driver for the introduction of sustainable fuels and carbon neutral energy carriers.
- The European Green Deal and Fit for 55 package increased the pressure on the automotive industry. These announcements contain among others new fleet emissions regulations, resulting in a ban of internal combustion engines in passenger cars and light vehicles in 2035.
- The restructuring of the 2022 roadmap can be linked to the new vehicle fleet emission regulations which foster the market introduction of battery and fuel cell electric vehicles.
- The internal combustion engine fueled solely by carbon neutral fuels is recommended as a suitable part of hybrid powertrains.

Technology Pathways Proposed by the A3PS Roadmaps

2022 Roadmap

Internal combustion engines fueled by renewable fuels will remain the common powertrain

Short-Term 2022-2025	Medium-Term 2025-2030	Long-Term 2030+
• ICE only mentioned as part of hybrid electric systems • Natural gas as energy carrier not listed for the first time	• Focus on BEV and FCEV • Renewable energy carriers have the largest potential to reduce GHG emissions • Reducing emissions by increasing bioethanol content to 20%	• ICE still relevant for heavy-duty applications • ICE only powered by renewable fuels

2018 Roadmap

Internal combustion engine will remain the dominant powertrain

Short-Term 2018-2025	Medium-Term 2025-2030	Long-Term 2030+
• Optimized conventional powertrains • Multi-fuel ICE (Hydrogen, methane) offer emission reduction potential • BEV improved but need to become more affordable • Reduce cost of FCEV	• Heavy Duty: Optimized diesel and gas engines • Depot-bound operations: BEV, FCEV, Hybrid vehicles	• Advanced feedstocks for sustainable fuels • Further alternative renewable energy carriers listed: OME, DME, biomethanol

2015 Roadmap

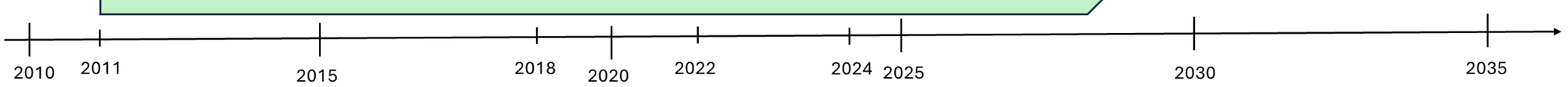
Internal combustion engine will remain the most dominant powertrain

Short-Term 2015-2020	Medium-Term 2020-2025	Long-Term 2025+
• Optimization of conventional ICE • Multi-fuel ICE (Hydrogen, natural/biogas) • Regarding CO_2: BEV, FCEV and Hybrid favorable • First FCEV entered the market	• Heavy Duty: Optimized diesel and gas engines • Depot-bound operations: BEV, FCEV, Hybrid vehicles • City buses early market for PEM-fuel cells	• Advanced feedstocks for sustainable fuel production • Alternative renewable energy carriers listed: Fischer-Tropsch, biomethane, hydrogen

2011 Roadmap

Internal combustion engine will remain the most dominant powertrain

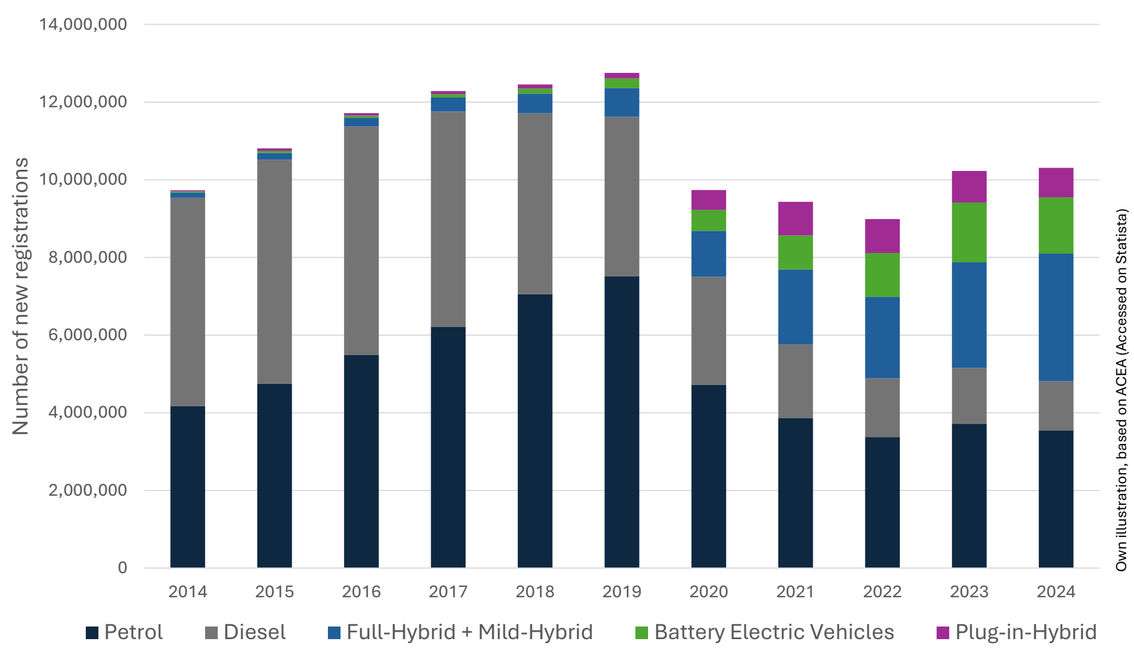
Short-Term 2011-2015	Medium-Term 2015-2020	Long-Term 2020-2030
• Optimization of conventional ICE • Multi-fuel ICE (Hydrogen, natural/biogas) • Hybrid Powertrains	• BEV, FCEV, Hybrids favorable regarding CO_2 emissions • Increase FAME and bioethanol content 10% • PEM-FC for city buses • Heavy-duty: optimized diesel and gas engines	• Increasing HVO content to 30% • Depot-bound operations: BEV, FCEV, Hybrids



Share of Powertrains among new Car Registrations in %	2010	2011	2015	2018	2020	2022	2024	2025	2030	2035
	Austria	EU	Austria	EU	Austria	EU	Austria	EU	Austria	EU
Conventional ICE	>95%	>98%	>95%	98%	95%	94%	58.9%	55%	50.5%	46.5%
Hybrid Electric Vehicles	-	-	-	2%	2.8%	5%	25.1%	33%	31.9%	39%
Battery Electric Vehicles	-	0.1%	-	0.45%	2%	1%	15.9%	12%	17.6%	13.5%

New Registrations of Passenger Vehicles by Powertrain in the European Union

- In 2024, 13.5% of all passenger cars sold were battery electric vehicles.
- The 2018 roadmap mentioned that battery electric vehicles have successfully entered the market and projected the increasing importance of these powertrains. Since then, the market share has risen from 1% to 13.5%.
- Of all new registrations in 2024, hybrid and battery electric vehicles in total accounted for 53%.
- In over 85% of all new passenger vehicles the internal combustion engine is still fully or partially used for propulsion. This highlights the dominance of this powertrain technology, which was also projected by all roadmaps.
- Since 2014 the share of diesel vehicles among new registrations has decreased from 55% to 12%.
- The significant drop-off in 2020 of new registrations was caused by the Covid-19 Pandemic and following supply chain shortages.



Poster created by Peter Straubinger

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