Fundamental change in the commercial vehicle industry: Possible developments through autonomous driving

Advancing Environmental Efficiency of Emerging Technologies

WS & FG-AI4EE (Vienna)
03.05.2022
Session 2: Digital twins for smart cities and the future of smart mobility

Agenda

WHY the sector of commercial vehicle is transforming

WHAT will be the impact on commercial vehicles?

HOW will the future logistic eco system likely be?

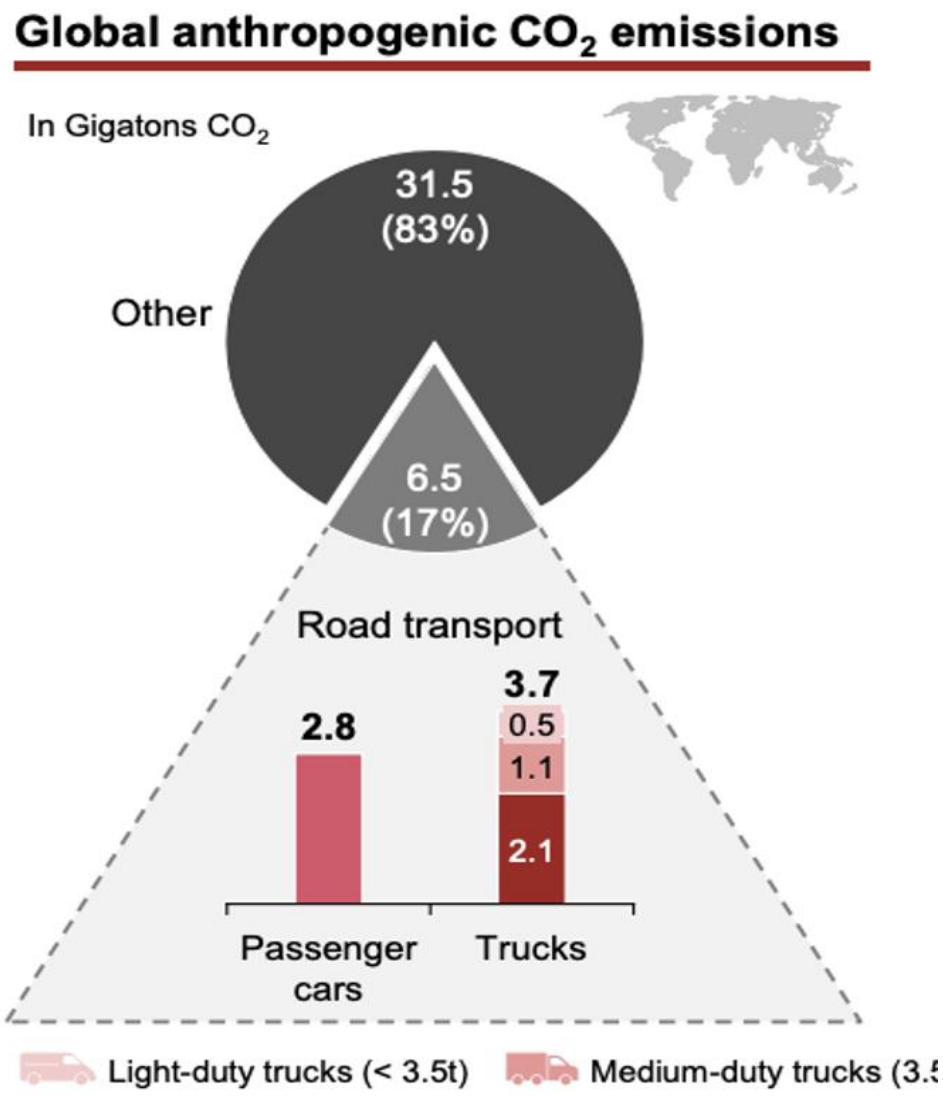
WHY - Megatrends with high impact on the logistic sector

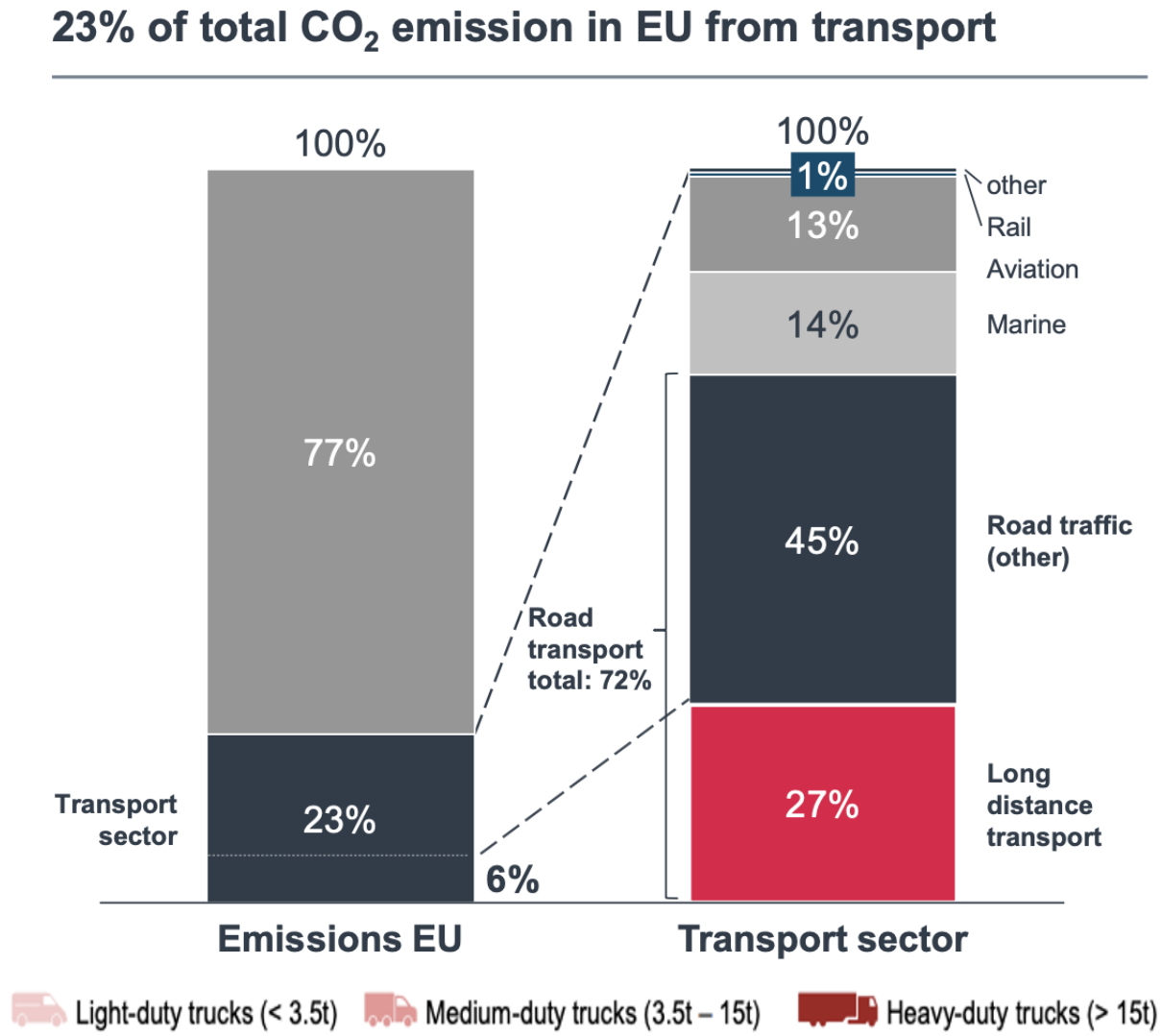
- Globalization

- Digitization

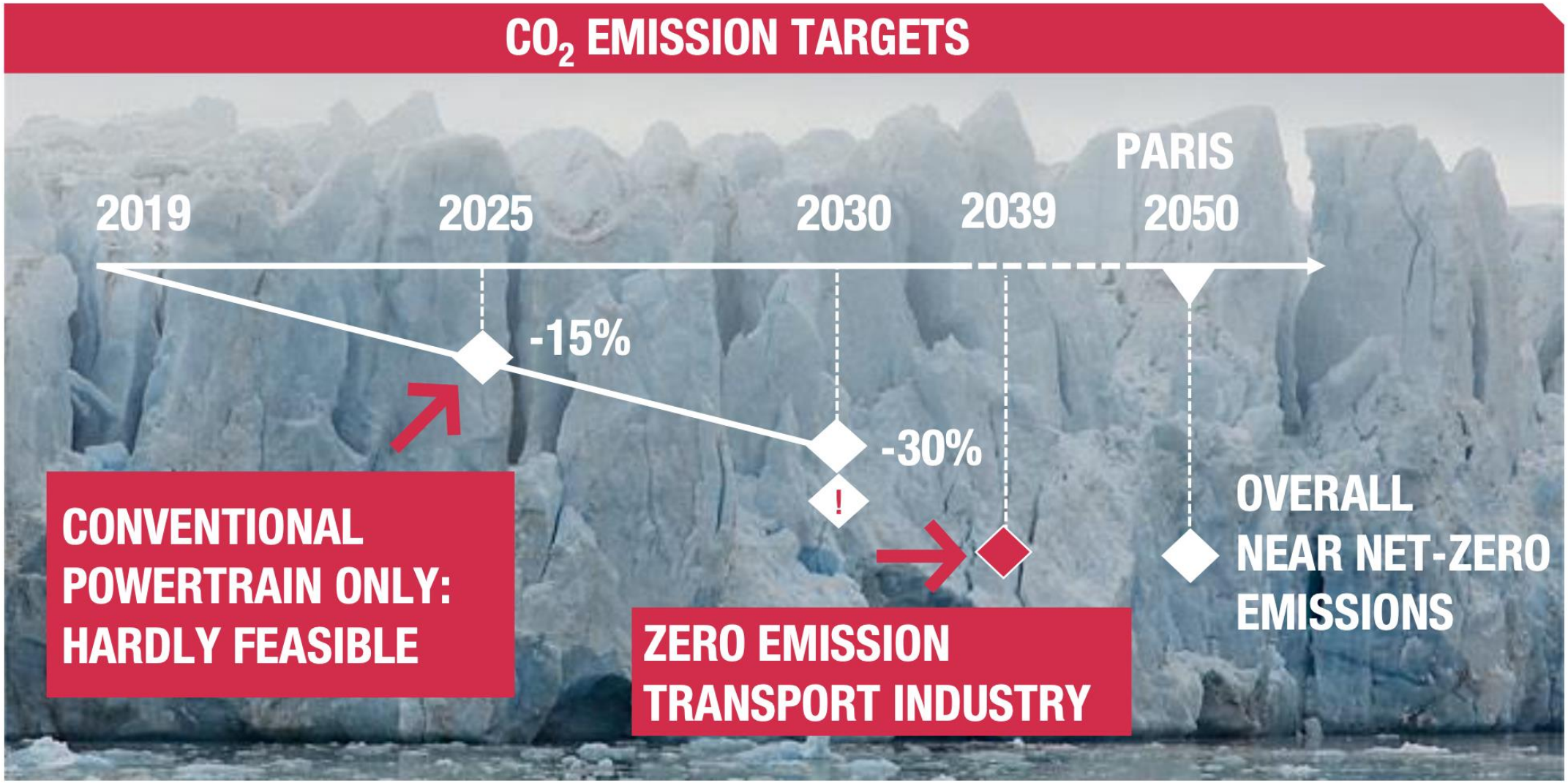
- Sustainability

WHY Logistics do matter?





WHY? IT IS DECIDED: LATEST BY 2039 THERE MUST BE 100% ZERO EMISSION TRUCKS ON THE ROAD



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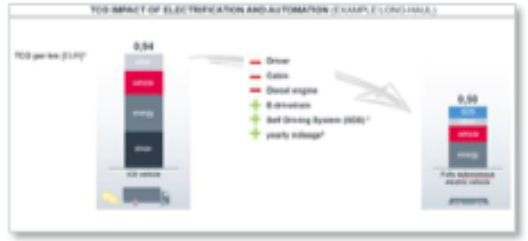
What will be the impact on commercial vehicle?

General shifts in eco-system

- **Driverless vehicles are a major "game changer":** Once technology & regulation are ready, quick ramp-up of fully autonomous, electric vehicles expected due to enormous cost savings
- **Vehicles will greatly reduce in complexity** with significant changes affecting >75% of today's value creation – **e.g., SDS Kit becomes a crucial success factor**
- **Cabless vehicles are part of long term goal 2030+,** along the way integration into existing vehicle layout needed to be fast to market and allocate budget to autonomous ramp up
- **Autonomous driving with huge impact on business models** – use cases first in hub-internal applications, then hub2hub, then in last mile / inner-city
- **Hub2hub** identified with **highest midterm scaling/business potential**
- **"OEM+SDS+TaaS" derived as most attractive business model** in the long-term



What will be the impact on commercial vehicle?

	Definition	Complexity	Revenue/ Volume Pool	
Confined area/ Hub 	**Autonomous operation in confined (non public) areas** ▪ Static areas: i.e. harbors, depots, fixed routes ▪ Dynamic areas, i.e. mining, construction sites **Segments**: Construction, Distribution, Municipality	 Specific operation domain **w/o interferences**	 Operating vehicle number and km **low**	**~ 10%** Of EU7 vehicles registr. 2019 operate in that use case
Hub-2-Hub 	**Autonomous operation on public roads** ▪ Between hubs (i.e. warehouses, distribution centers) ▪ Mainly on highways **Segments**: Longhaul, reg. Distribution, (Construction)	 Specific operation domain with **expected interferences**	 Operating vehicle number and km **high**	**~ 65%** Of EU7 vehicles registr. 2019 operate in that use case
Urban 	**Urban goods distribution on public roads** ▪ Complex rural area (i.e. milk runs/s-market delivery) ▪ Excluding last mile and only B2B delivery **Segments**: Longhaul, reg. Distribution, (Construction)	 Specific operation domain with **unexpected interferences**	 Operating vehicle number and km **medium**	**~ 25%** Of EU7 vehicles registr. 2019 operate in that use case

Order of development

Agenda

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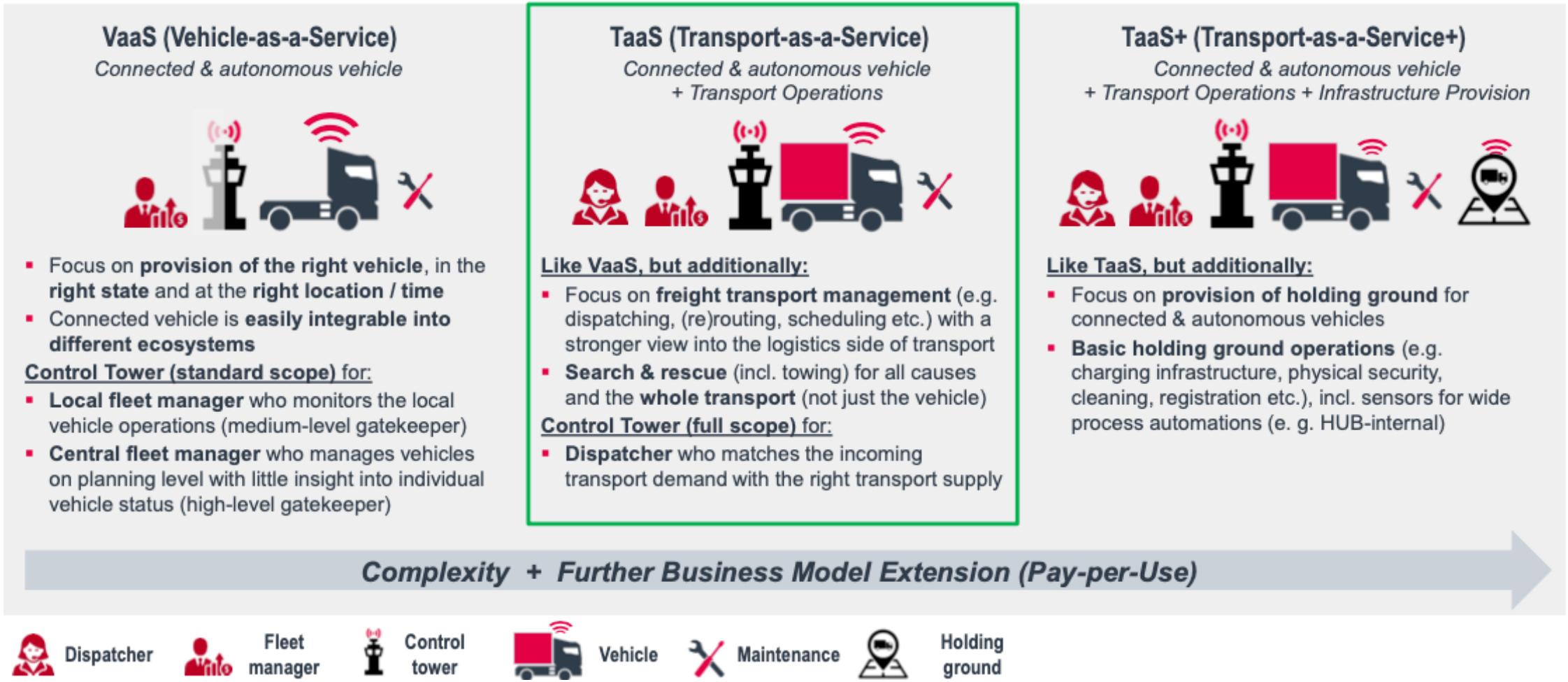
How will the future logistic eco system be ?

	Competition	Legislation	Expected market ramp up
Confined area/ Hub		Already allowed **TODAY**	
Hub-2-Hub		Ability to homologize **Germany (2022)** **EU (~2023-2025)**	
Urban		Ability to homologize **Germany (2022)** **EU (~2023-2025)**	

How will the future logistic eco system be ?



Backup

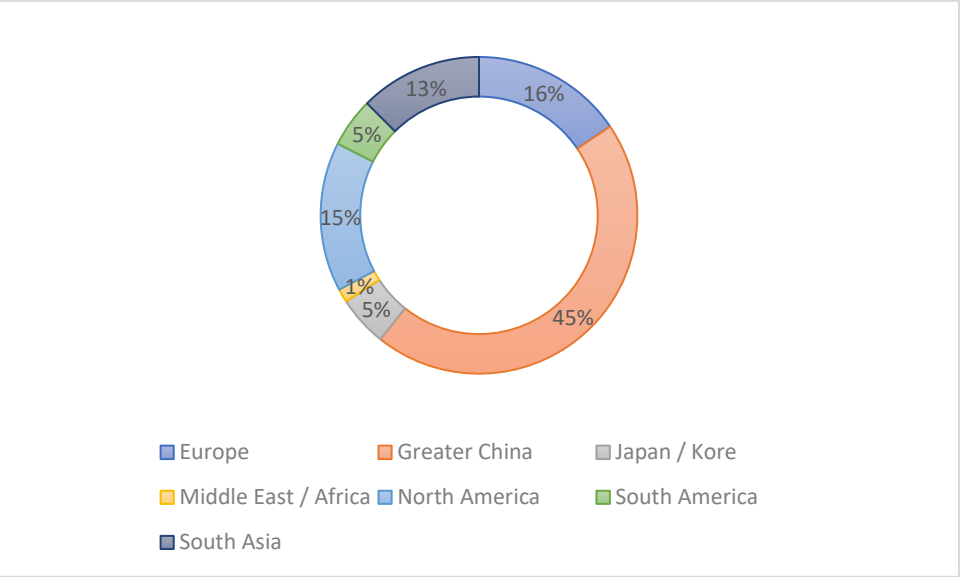
WHY – changes in the business modell for commercial vehicles

		Mercedes-Benz	Scania	Volvo	Renault Trucks	Iveco
Targets (2020+)	Ambition	European production CO_2 neutral by 2022; fleet carbon neutral 2039	Cut 50% of CO_2 emissions in operations and 20% from products by 2025, achieve fossil free transport until 2050	Trucks 40% more fuel-efficient than 40y ago – now committed to achieve 1% efficiency gains p.a., No carb. neutrality target	Reducing carb footprint of vehicles sold by 25% by 2022 (Renault Groupe incl. PVs)	No specific IVECO target, 80% of energy consump. from renewable sources (CNH Group)
	Credibility	SBTi-certified[1]	ISO 14001 certified[2] SBTi-certified	Following REACH[3] regulation, ISO 14001 certified	ISO 14001 certified	No certification, silent actor
Measures	Substance	By 2022 eCitaro/eActros, by end of decade fuel-cell technology (JV with Volvo)	Improving production & efficiencies, use of 100% renewable energy in production by 2020	Focus on recyclable products (90% of truck), Carb. neutrality of plants & dealers	Focus on recyclable products, 100% renewable energy for production since 2019	Efficiency improvements of diesel engines
	Radiance	Lighthouses: vehicles (eActros), utilization renewable energy	Lighthouses: L-/P-series electric truck, Ecolution service, "Oberleitungs" pilot on A5 in Germany with R450 vehicles	Lighthouses: vehicle offering (FL Electric), utilization renewable energy	Lighthouses for vans (Master Z.E.), trucks announced, and service (Optifuel)	Lighthouses: vehicle offering (Biogas, hybrids), Nikola cooperation
		Leader: Ambitious	Leader: Ambitious	Leader: Compliant	Follower: Opaque	Follower: Opaque

1. Science-based targets initiative, 2. ISO 14001 is the international standard for designing and implementing an environmental management system,
3. REACH stands for Registration, Evaluation, Authorization and Restriction of Chemicals
Note: Only trucks/vans divisions and newly sold vehicles considered
Source: Sustainability reports, BCG analysis

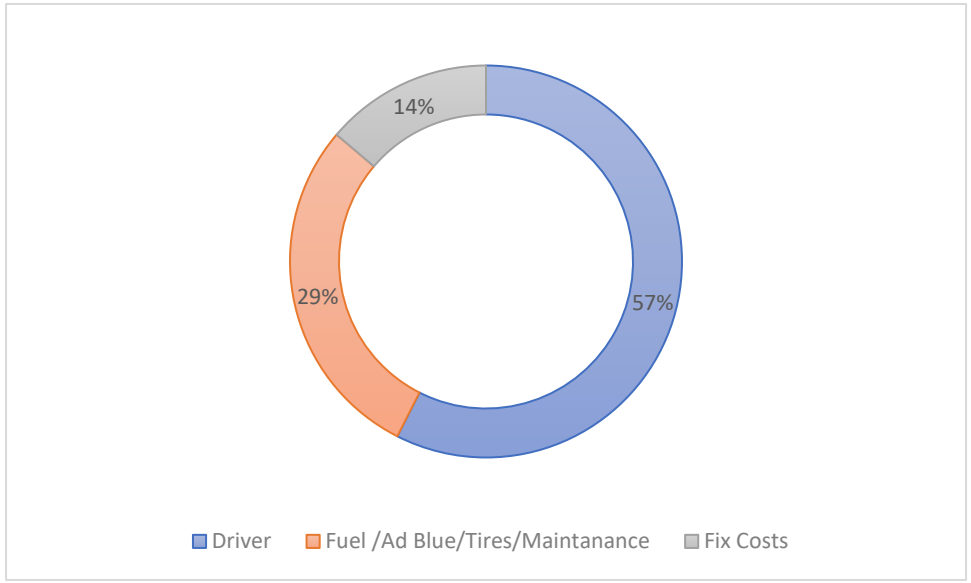
Level: High, Medium, Low

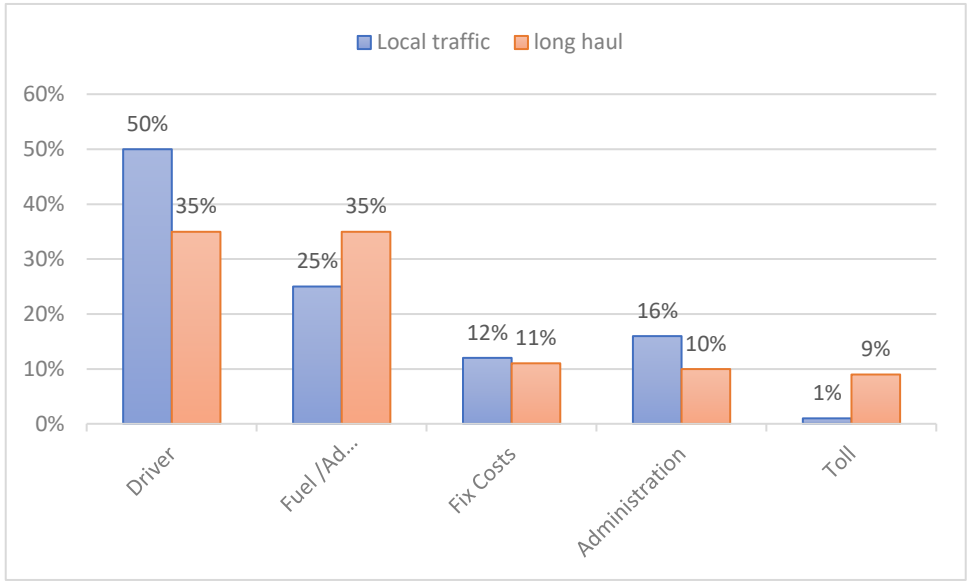
Commercial Vehicles-Market



	2021	2022	2023	2024	2025	2026	2027	2028	2029
Europe	568.877	608.549	672.760	672.760	694.572	685.947	694.572	690.221	704.534
Greater China	1.656.079	1.373.696	1.327.255	1.358.911	1.490.818	1.529.725	1.525.454	1.525.454	1.423.655
Japan / Kore	189.136	193.073	194.106	198.202	189.823	190.093	192.696	195.780	196.465
Middle East / Africa	50.118	51.706	53.564	56.246	58.480	61.043	63.122	62.948	64.091
North America	558.986	662.349	620.040	612.987	615.777	634.403	629.711	632.999	636.915
South America	184.341	204.253	174.688	190.445	189.099	194.938	193.523	206.657	207.959
South Asia	458.176	516.318	612.483	649.013	682.596	645.975	690.418	722.976	742.991
Grand Total	3.665.713	3.609.944	3.654.896	3.738.564	3.921.165	3.942.124	3.989.496	4.037.035	3.976.610

What is relevant for the market? TCO!





Costs	Local traffic	long haul
Driver	50%	35%
Fuel /Ad Blue/Tires/Maintanance	25%	35%
Fix Costs	12%	11%
Administration	16%	10%
Toll	1%	9%

BESIDE REGULATION, COMPETITION AND CUSTOMERS WILL DRIVE THE MARKET NEED FOR EMISSION TRUCKS FROM 2021

Old Player are changing and advertising Zero Emission products soon

- All European OEMs (Daimler, Volvo, Iveco and DAF) have zero emission heavy trucks coming out soon (2020 / 2021)
- Joint Ventures by Daimler / Volvo and Iveco / Nikola add technological flexibility and risk sharing in FCEV development

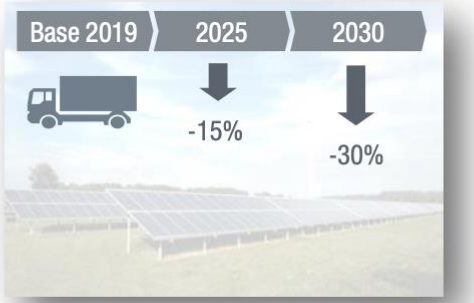
New Player contribute to a rapid Zero Emission Technology development

- Tesla and Nikola challenge the establishment by innovative BEV (2021) and FCEV trucks (2023)
- Tesla announce plans to reduce overall KWh cost by 56% until 2023
- New Asian players, e.g. BYD, Hyundai

Customer want to take the responsibility for their green house gas emissions

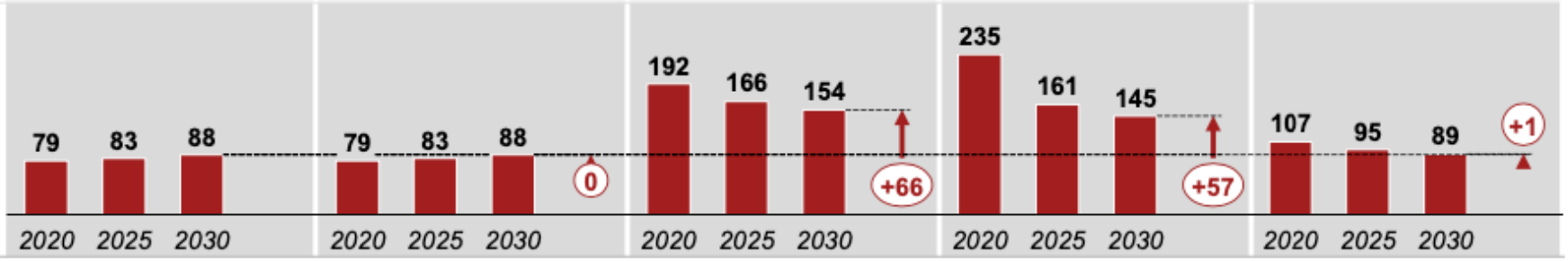
- Beside some early adopters (e.g. IKEA, UPS) most customers have determined their way of decarbonisation and sustainability
- Cities are frontrunner for Zero Emission trucks and busses

Regulation CO_2 and further emission requirements become stricter



- 7% points to the 15% CO2 target of MAN by 2025 must be achieved by BEV to avoid penalties of 400+ m€
- Additional actions on city entry restrictions and Clean Vehicle Directive (CVD) exacerbate the situation

HOW will be the transformation?

Criteria	ICE	SYT	BET	FCT	CAT
					
Power	300 kW	300 kW	300 kW	300 kW*	300 kW
Energy on board	700 liter (Diesel)	700 liter (SynFuel)	500 kWh	60 kg (hydrogen) + 50 kWh	100 kWh
Range	1,500 – 2,000 km	1,500 – 2,000 km	400 – 500 km	700 – 800 km	Depends on infrastructure [Independent: 40 – 80 km]
Powertrain weight	2,200 kg	2,200 kg	4,300 kg	2,300 kg	1,100 kg
Vehicle price evolution (€)					

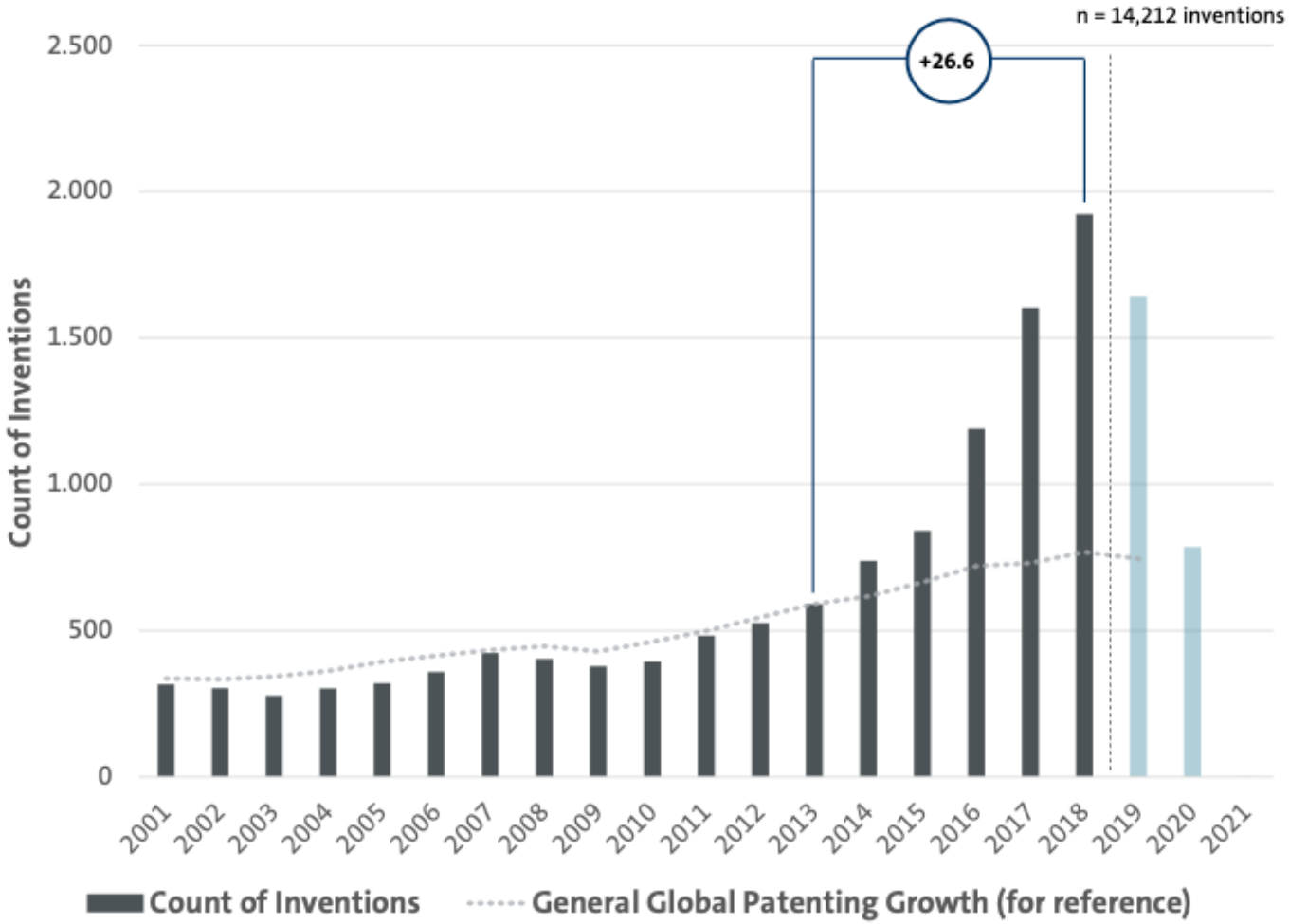
Powertrain cost in k€ | XX On-costs vs ICE 2030 | SynFuel – synthetic diesel fuel | Hydrogen is stored at 700bar | *thereof 200kW fuel cell

Source: Strategy& analysis

Source: Strategy& (2020), p. 12

HOW will be the transformation?

Autonomous Driving Trucks
Global patent activity



*Patents are usually disclosed 18 month after application. Therefore values for 2019-2021 may be incomplete.

KEY INSIGHTS

Ø Annual growth rate in %

- **Research efforts have been strongly increasing in recent years.**
- **Innovation activity has been increasing with an outstanding average of 26.6% p.a. (CAGR).**
- **For comparison: Global patent activity across all technologies increased with an average of 8% p.a. (CAGR).**