Electrifying road transport in Norway

Status and potential

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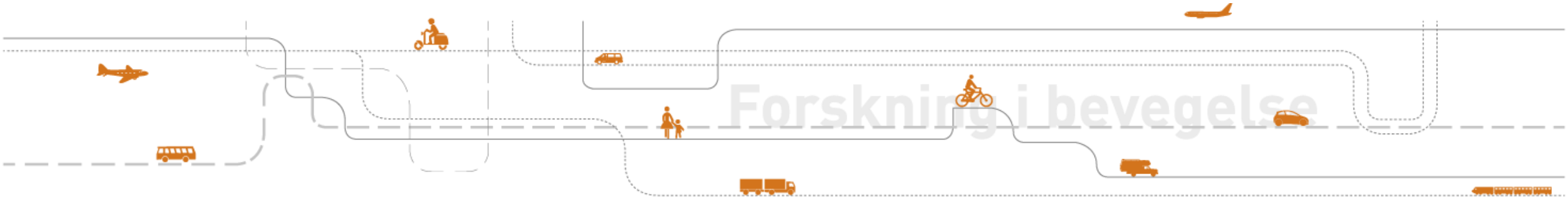
10. May 2021

Webinar: Status update on lithium-ion battery technologies and the electrification of road transport in Norway



Norway - the World Leader in BEV adoption

04/2021: 13% BEVs + 5% PHEVs in fleet

Total numbers > 500 000

Ambitious climate policy targets
Large package of incentives

Driving forces:

EU: CO_2-regulation, Norway: National Transport Plan Targets

	EU regulation 2025	EU regulation 2030	NTP 2025 New vehicles	NTP 2030 New vehicles
Passenger vehicles (cars)	-15%	-37,5%	100% ZE	
Small Light Commercial Vehicles	-15%	-31%	100% ZE	
Large Light Commercial Vehicles	-15%	-31%		100% ZE
Trucks >16 tonn	-15%	-30%		50% ZE
Trucks ≤16 tonn	None	None		50% ZE
City buses	None	None	100% ZE	
Regional buses and coaches	None	None		75% ZE

ZE=Zero Emission (vehicle)

⇨Cost reductions batteries (volumes/commodization)

⇨Massive roll out of Battery Electric Vehicles in all segments

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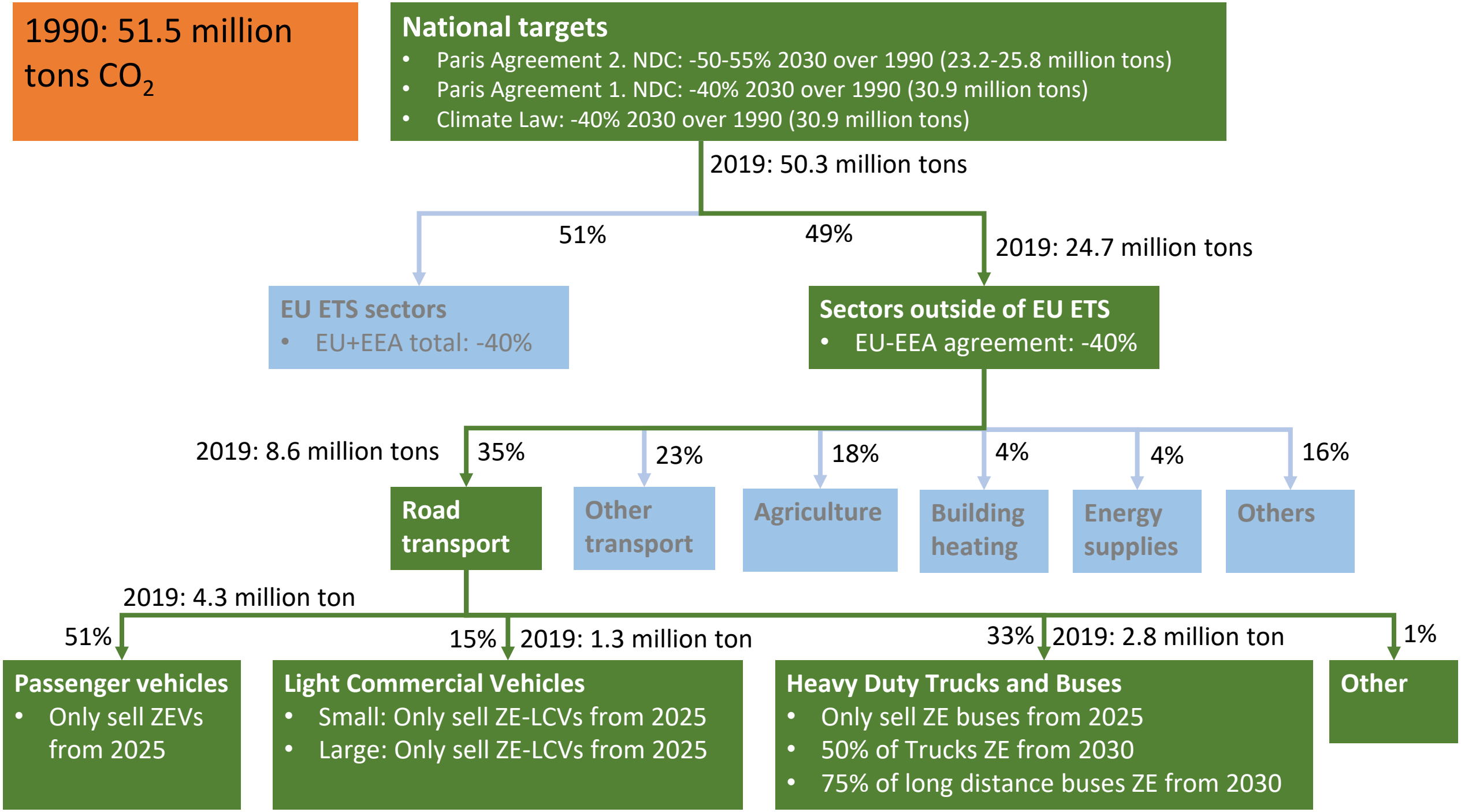
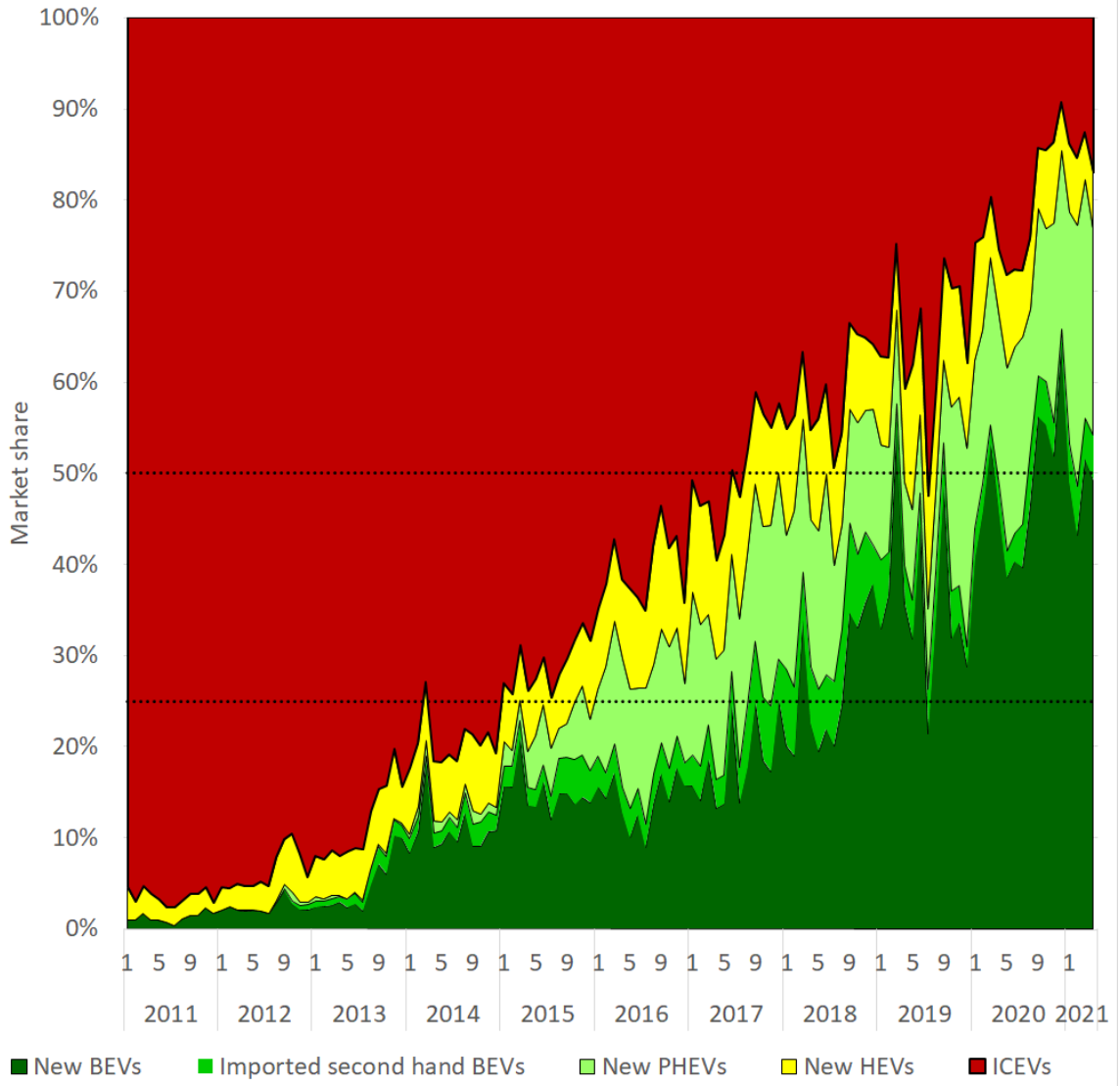

1990: 51.5 million tons CO_2
National targets
• Paris Agreement 2. NDC: -50-55% 2030 over 1990 (23.2-25.8 million tons)
• Paris Agreement 1. NDC: -40% 2030 over 1990 (30.9 million tons)
• Climate Law: -40% 2030 over 1990 (30.9 million tons)
2019: 50.3 million tons
51%
49%
2019: 24.7 million tons
EU ETS sectors
• EU+EEA total: -40%
Sectors outside of EU ETS
• EU-EEA agreement: -40%
2019: 8.6 million tons
35%
23%
18%
4%
4%
16%
Road transport
Other transport
Agriculture
Building heating
Energy supplies
Others
2019: 4.3 million ton
51%
15%
2019: 1.3 million ton
33%
2019: 2.8 million ton
1%
Passenger vehicles
• Only sell ZEVs from 2025
Light Commercial Vehicles
• Small: Only sell ZE-LCVs from 2025
• Large: Only sell ZE-LCVs from 2025
Heavy Duty Trucks and Buses
• Only sell ZE buses from 2025
• 50% of Trucks ZE from 2030
• 75% of long distance buses ZE from 2030
Other

Passenger vehicles – Market share 2020: 54%



- EU CO_2-regulation

- VAT (25%) exemption (2001)
- Registration tax exemption (1990)
- Annual tax reduction/exemption (1996)
- Reduced company car benefit tax (2000)

- Road tolls exemption/reduction (1997)
- Parking, free or reduced fee (1999)
- Access to bus lanes (2003/2005)
- Reduced rates on main road ferries (2008)

- Support for infrastructure (mainly from 2010)
  - *Fast chargers along major roads 2015-2020*
  - *Chargers in parking areas for flats*

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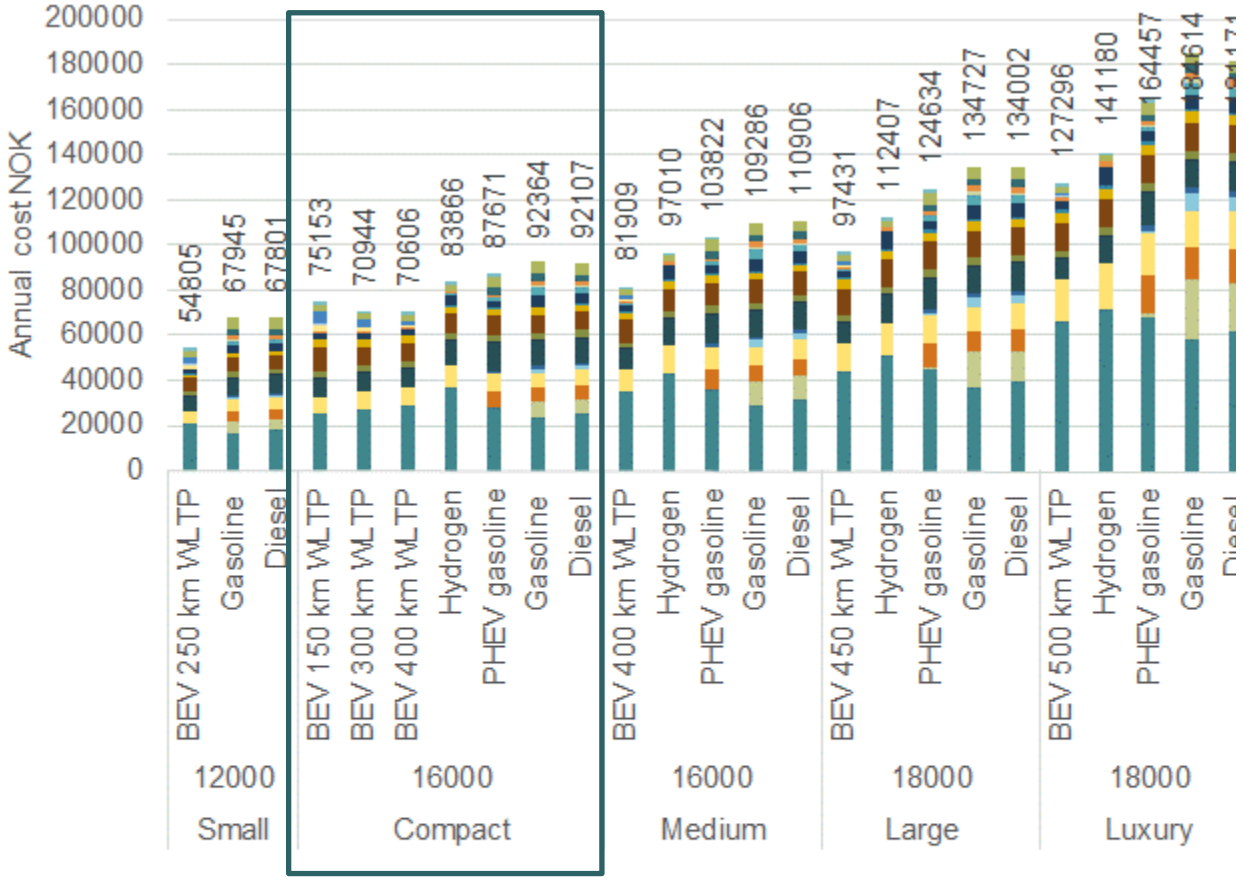
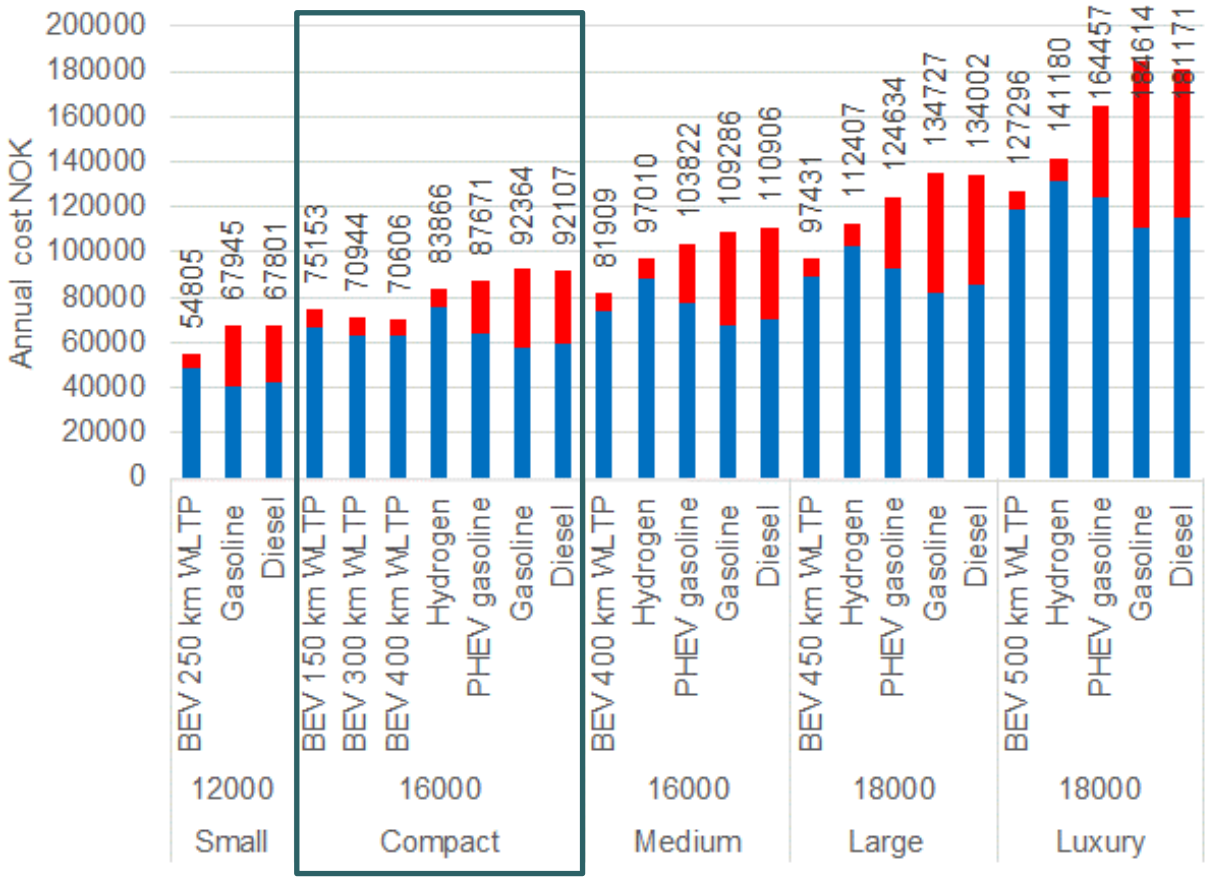
BEVs have the lowest TCO (since 2012-2015)

2025 example – wirth current incentives (parking/ferries/bus lane incentives not included)





- Vehicle depreciation
- Vehicle capital cost
- Maintenance cost
- Tires
- Energy tax
- Fast charge cost
- Annual tax
- Purchase taxes depreciation
- Purchase taxes capital cost
- Maintenance VAT
- Tires VAT
- CO2 tax fuel
- Fast charge VAT cost
- Road tolls
- VAT depreciation
- VAT capital cost
- Insurance
- Energy cost
- VAT Energy
- Fast charge time cost
- Charging infrastr. depriciation

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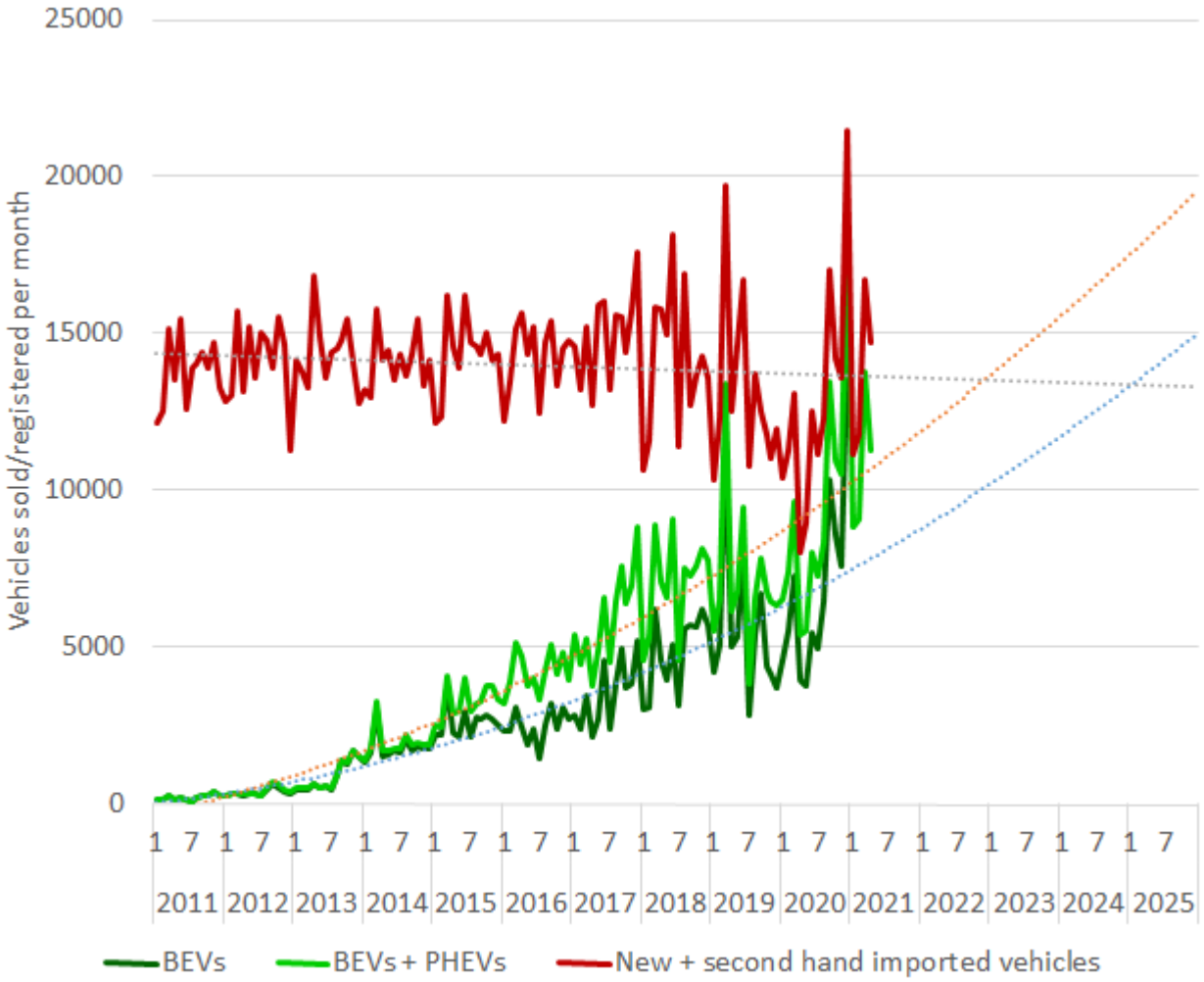
Will the target be met?



Ambitious targets requires a continuing incentive package

AND

higher taxes on gasoline and diesel vehicles as some incentives will be reduced

EU CO_2 regulation removes volume limitations and leads to a rapid increase in available models in all segments/all brands

Ca. 40 BEV models in 2020

Ca. 180 BEV and 110 PHEV models in 2025

Europe is catching up with Norway

Figure 38: 2020 Europe passenger BEV and PHEV sales, by country

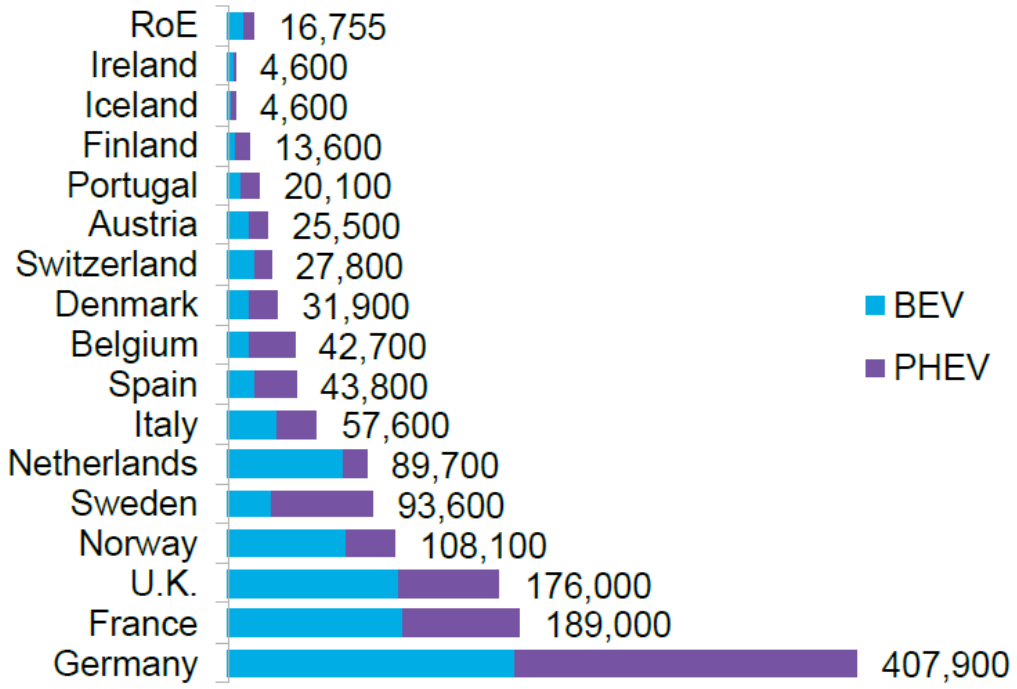
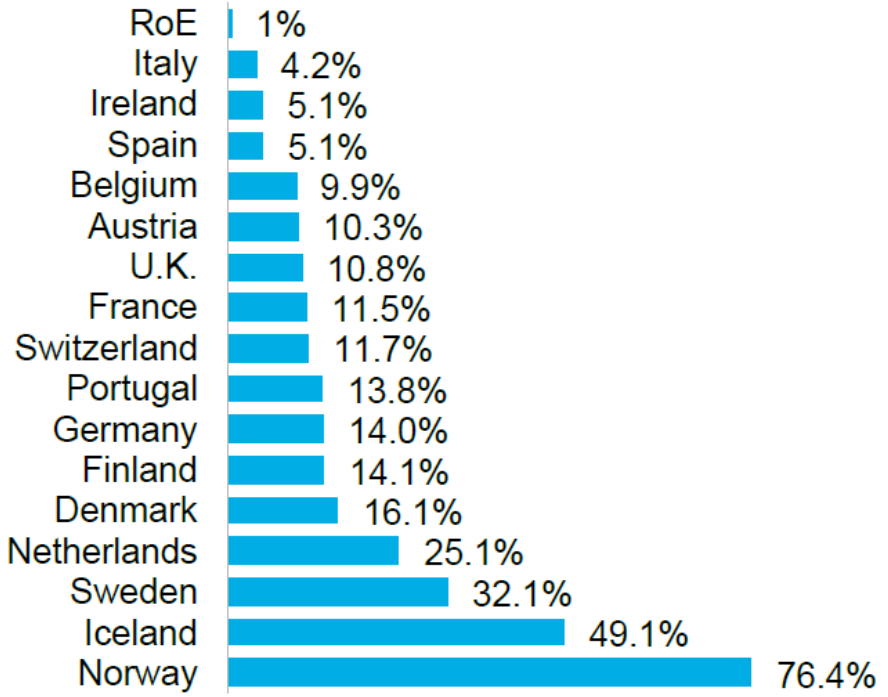


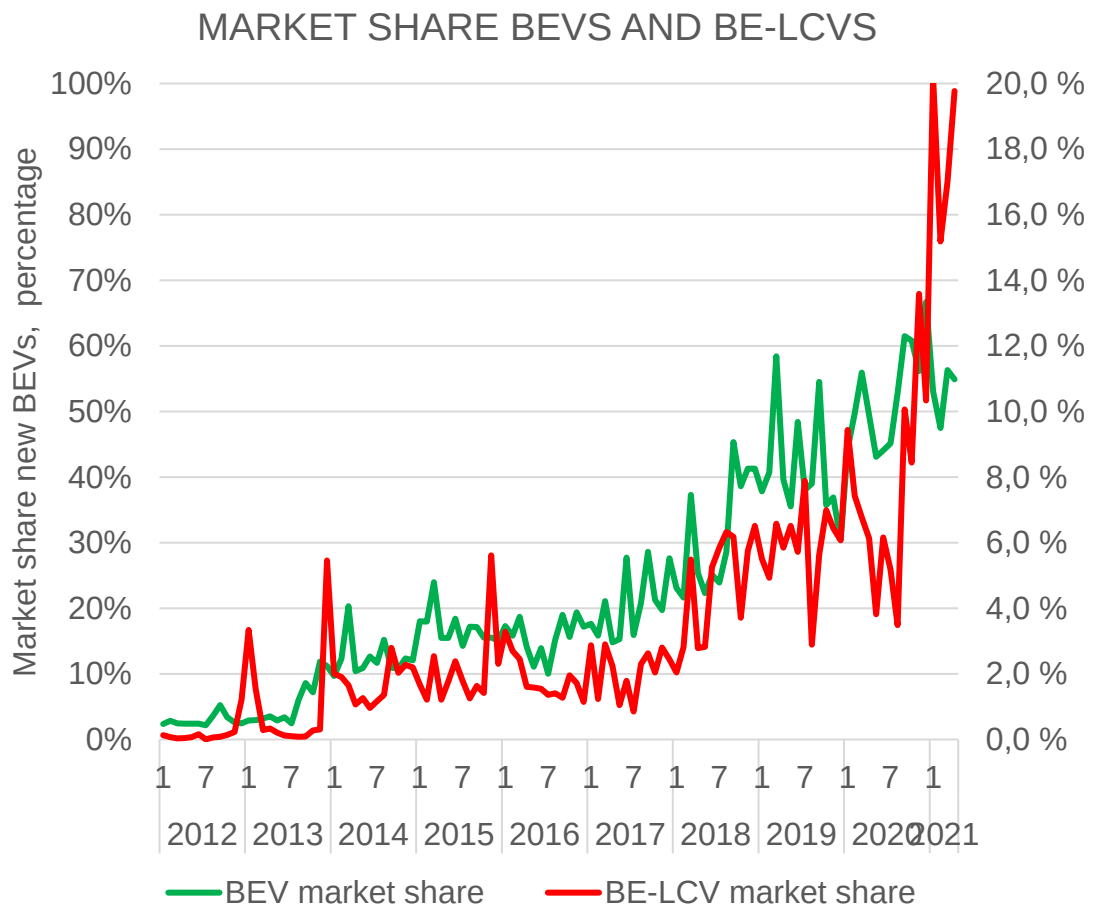
Figure 39: 2020 Europe EV share of total passenger vehicle sales



Source: BloombergNEF, Marklines, Bloomberg Intelligence, vehicle registration agencies, EV Sales Blog, EAFO. Note: Europe data includes EU27 countries plus Norway, Switzerland, Iceland and the U.K. EV sales include BEV and PHEV sales.

Source:
https://www.transportenvironment.org/sites/te/files/publications/2021_05_05_Electric_vehicle_price_parity_and_adoption_in_Europe_Final.pdf

Battery Electric Light Commercial Vehicles
Market share 2020: 8.5%



- EU CO_2-regulation

- ~~VAT (25%) exemption~~ ENOVA support
- Registration tax exemption
- Annual tax reduction/exemption
- ~~Reduced company car benefit tax~~

- Road tolls exemption/reduction
- Parking free or reduced fee
- Access to bus lanes
- Reduced rates on main road ferries

- Support for infrastructure
  - *Fast chargers along major roads*
  - *Chargers in parking areas for flats*
  - *Chargers at depots*

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New Generation Battery Electric LCVs

BE-LCV Market share 2020: Small sized:14%, Medium+Large: 3%

User needs*

- Fast charging
- Payload as for diesel
- Tow hook
- Model selection
- Range all year 200 km
- Medium/Large LCVs

Small LCVs ✓

- Up to 100 kW
- Payload as for diesel
- Tow hook
- Large number of models/configurations
- Range up to 275 km (170 km Winter)

Can cover up to 100% of needs

Medium LCVs ✓

- Up to 100 kW
- Payload as for diesel
- Tow hook
- Many models/configurations
- Range up to 330 km (200 km Winter)

Can cover up to 100% of needs

Large LCVs ?

- Up to 100 kW
- Payload as for diesel
- No Tow hook
- Some models/configurations
- Shorter range in general

Limited use

*Figenbaum E. (2018). Can Battery Electric Light Commercial Vehicles work for Craftsmen and Service Enterprises? Energy Policy 120 (2018) 58-72. https://www.sciencedirect.com/science/article/pii/S0301421518302866

Remaining barrier: 4-wheel drive is not available

MOZEES Mobility Zero Emission Energy Systems

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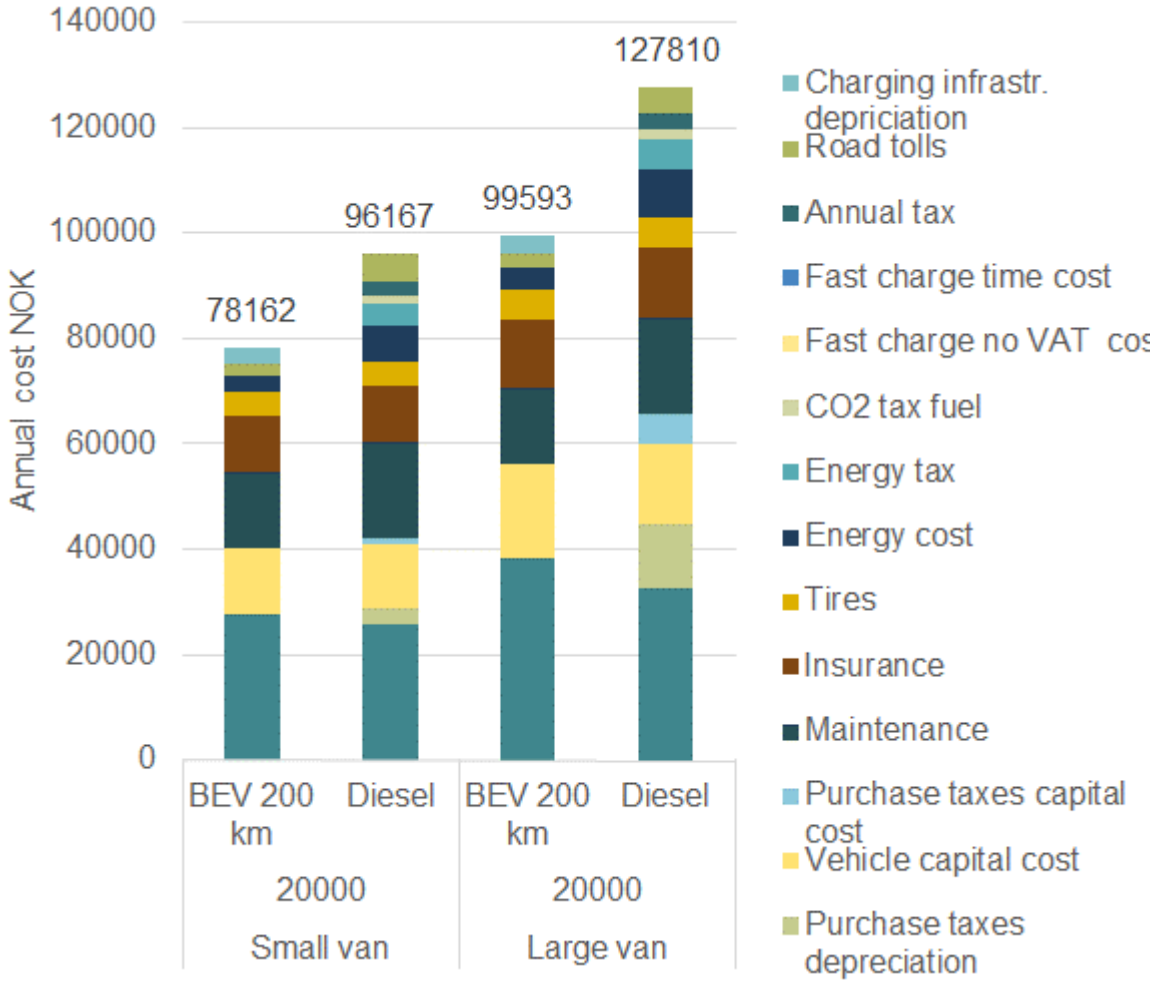
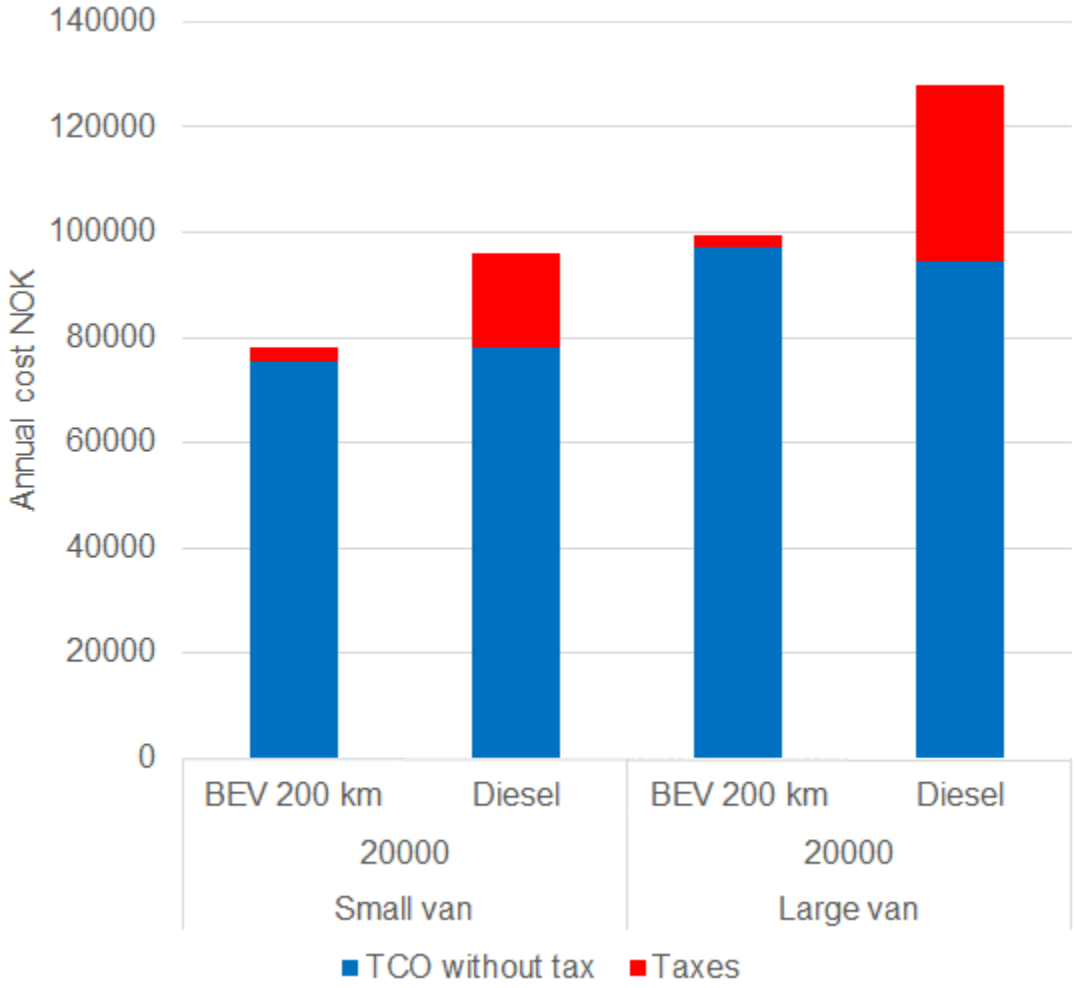
BE-LCVs have the lowest TCO (since 2015-2017)

2025 example – wirth current incentives (parking/ferries/bus lane incentives not included)





Buses

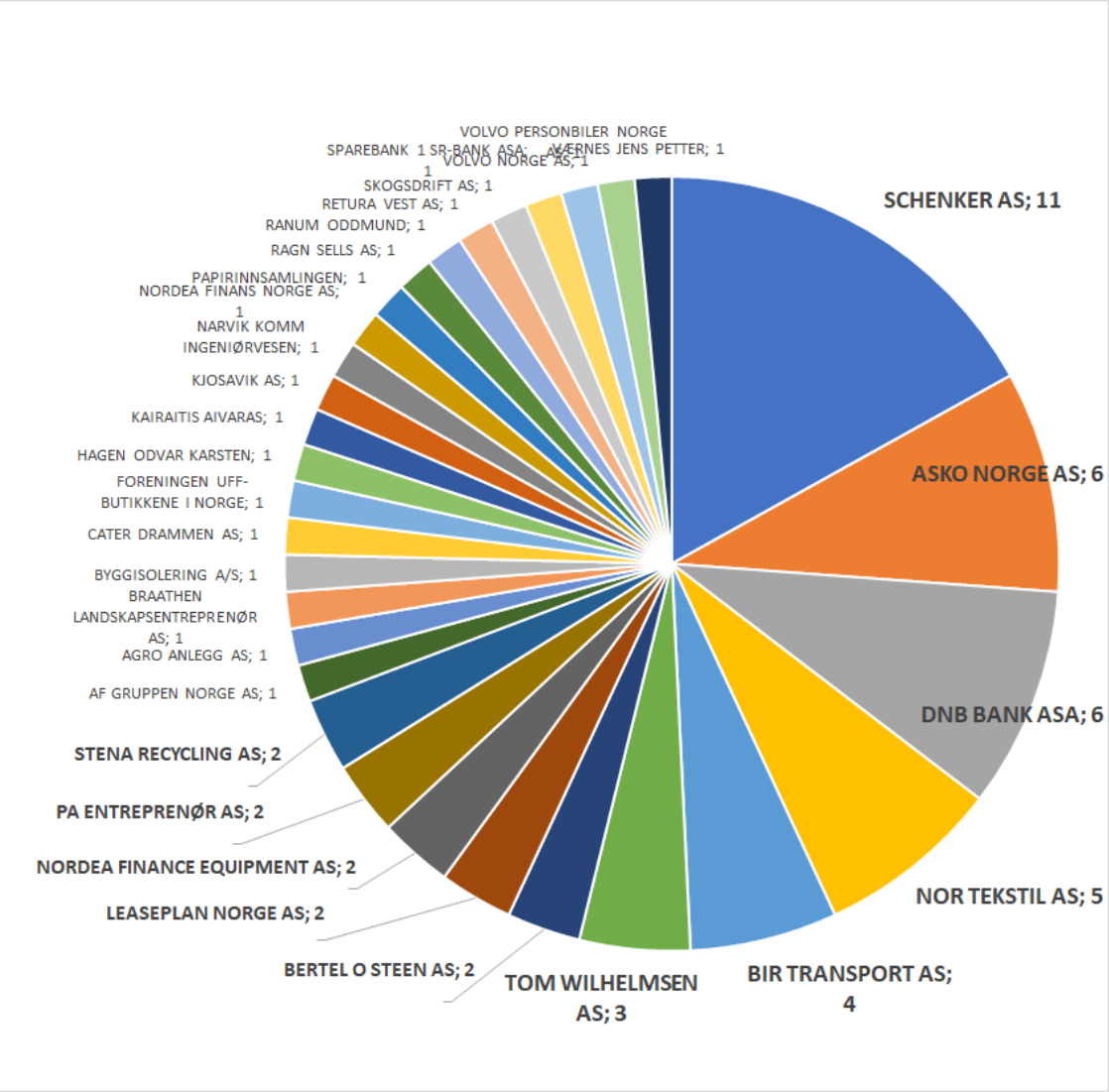
City buses ✓

- Battery electric
  - *Transportsystem – Battery size, charging infrastr. tradeoff*
  - *Class I and Class II, 9-10m, 12m, 15m, 18m, 24m, BRT*
  - *Battery up to 480 kWh (12m) and 640 kWh (articulated)*
  - *In use: 403 (01.01.2021) (Oslo, Drammen, Trondheim others)*
- Hydrogen: Available from more than one supplier
- Public tenders

Regional/Coaches ✓

- Battery electric
  - *Coaches: Charging needs and technology as trucks*
  - *Class III, Class II, 10,6m, 12, 14m, 15m*
  - *Battery up to 676 kWh*
  - *In use: 50 (01.01.2021), Oslobuss, Tide, Boreal*
- Hydrogen: Could potentially be used but no suppliers
- Public tenders / Private enterprises

Battery Electric Trucks – Just getting started (65 in use)



- Major barriers:
  - *Infrastructure – Non existent, depot charging used*
  - *Investment cost currently 2-3 times that of diesel*
- EU CO_2-regulation
  - *Full series production initiated*
- Purchase incentives:
  - *ENOVA, Purchase Support Program*
- Local incentives:
  - *Road toll exemption (up to 120 000 NOK/year)*
  - *At least 50% reduction on ferry rates*
  - *Access bus lanes (some restrictions)*

Battery electric trucks in all segments – Demo and niche market

65 Battery electric trucks currently in use

Characteristics	<16 ton	16-18 ton	27 ton	> 27 ton	Long haul
Battery size	83-150 kWh	200-400 kWh	165-350 kWh	220-435 kWh	540-870 kWh brutto 430-700 kWh netto
Range summer	100-190 km	200-400 km	125-270 km	140-270 km	300-470 km
Range winter	75-140 km	150-300 km	95-200 km	100-200 km	230-370 km
Depot charging	22 - 43 kW AC	22-43 kW AC 50 kW DC	22-43 kW AC 50 kW DC	22-43 AC 50 kW DC	50-100 kW DC
Fast charge power	100 kW	80-150 kW	80-150 kW	120-250 kW	250-1000 kW DC
Payload*	Unchanged	Unchanged	Unchanged	Unchanged/reduced	Reduced
Suppliers	Few	Many	Many	Many	Starts from 2022
Comment	2-axles	2-axles	2- and 3-axles	2- and 3-axles	2- and 3-axles

*Relative to diesel

Transition from rebuilt diesel vehicles to series production by traditional truck producers

⇨ **Service availability as for diesel vehicles**

Heavy trucks – Others: Hydrogen, liquid Biogas

Demoprojects and niche market

Hydrogen – Demoprojects until 2025, industrialization possible 2025-2030

- Asko/Scania demo project
  Rebuilt 4 trucks
- Volvo/Mercedes joint venture-
  Production towards 2030
- Iveco/Nikola joint venture
  First as battery electric
- Hyundai. Truck on sale
  1600 to be produced by 2025

- Hydrogen refueling: Currently
  1 internal at Asko, Trondheim

Biogas

- Long range
- Several vehicle suppliers
- 2 filling stations (Oslo, Skogn)
- Limited resource

Conclusion
- Efforts required

	Status						
	Technology	Meeting user needs	Market	Infrastructure	Costs with incentives	Policy, incentives	Knowledge
Only sell Zero Emission (ZE) Passenger Vehicles from 2025							
Only sell ZE Small Light Commercial Vehicles from 2025							
Only sell ZE Large Light Commercial Vehicles from 2030							
50% of new HD trucks ZE from 2030							
Only sell ZE City Buses from 2025							
75% of new Coaches/Long distance buses ZE from 2030							