Experiences from battery-electric truck users in Norway

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Contents

- Battery electric trials in Norway
- User Experiences
- Potential for electrification
- Costs of operations

Pilots with battery electric trucks in Norway

Since 2016:

Since 2018:

Since 2019:

31.12.2018: ∑ = 13

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Incentives for purchasing electric trucks in Norway

- **Either**
  - Demand for **zero emission** solutions in **public tenders**
- **Or**
  - **Subsidies** for a share of added costs
    (Enova and Norwegian Environment Agency)
- **Exemptions from road toll and ferry charges**
- Bus lane **access**

- User Experiences

User experiences

- **Case study** based on semi-structured interviews of
  - Enterprises with **experience in operating battery-electric trucks** in Norway
  - Sample based on the **project list of ENOVA** (the Norwegian Government Agency for the transition towards a low-emission society), and the **Norwegian Public Road Administration's vehicle registry Autosys, as of Dec 2019**
- Interviews with people **closely involved in vehicle purchase in each firm**
- **Interview questions** were related to **purchase process**, **technology, performance**, service/maintenance, charging infrastructure, use of the existing fleet, **investment and operation costs**, **public frameworks** and incentives for enforced in-phasing of zero-emission vehicles

Technical information about the vehicles

	Operator 1	Operator 2	Operator 3	Operator 4	Operator 5	Operator 6	Operator 7	Operator 8
Vehicle type	Heavy van	Distribution truck	Distribution truck	Refuse collection truck	Refuse collection truck	Refuse collection truck	Refuse collection truck (Tractor)	Tractor
Manufacturer	Iveco	Iveco	MAN/ Emoss	Dennis Eagle/ PVI	DAF/Emoss/ Geesinknorba	DAF/Emoss/ Geesinknorba	MAN/Emoss/ Allison	MAN/Emoss/ Allison
Expected range (km/y)	30 000		50 000	18 000	20-26 000		80 000	120 000-130 000
Stated range km/charge	160	200	180	140	170	140	200	178
# of vehicles	5	1	1	2	1	1	1 (+1)	2
Registration year	2018	2018	2016	2018	2018	2018	2018 (2019)	2018
Total weight (t)	5.6	5.6	18.6	27.0	12.0	12.0	28.0 (50.0)	50.0
Pay load (t)	2,6		5.5	9,7	2.0	3.5	18-19	25
Engine power	80	60	195	118	150	198	250	370
Battery power (kWh)	80	60	240	240	120	130	200 (300)	300
Battery technology	Na-NiCl2	Na-NiCl2	Lithium-ion	Lithium-ion	Lithium-ion	Lithium-ion	Lithium-ion	Lithium-ion
Depot charging	22 kW	32A (22 kW)	2x43 kW,	64A (44 kW)	22 kW	44 kW	44 kW	44 kW
Opportunity charging					44 kW		150 kW	2x150 kW
Charging time (hrs)	Overnight	2	5	8 (overnight)	lunch break/ overnight	lunch break/ overnight	lunch break/ overnight	4-6/0.5

Main benefits

- Silent
- Low energy costs
- No emission or pollution
- No shaking or vibration
- Good working environment
- Positive attention from society

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Main challenges

- **Long time** from purchase to vehicles are in traffic
- High investment costs
- Battery weight **reduce payload** compared to similar trucks with ICE
- Heavy vans **registered as trucks** (driver licence C1, not B), difficult to recruit drivers
- **Lower range** gives **less flexibility,** more needs for route optimisation
- Too **little power** in steep slopes (some vehicles) => Reprogrammed by supplier
- Problems with **high-voltage cables** #2
- Time consuming **follow-up and problem solving**
- External power to **refrigeration units**

- (Establishing) **Fast charging** infrastructure
- Sufficient power for fast charging during periods of high power consumption

- Potential for electrification

Truck segments with early stage electrification potential

- Trucks with:
  - Engine less than 500 h.p. (horsepowers)
  - Do not use trailer (except citytrailer)
  - Maximum daily mileage shorter than the range of a fully charged battery
    - Access to fast charging increase potentially maximum daily milage
- Transport patterns studied for:
  - Trucks up to 5 years old (6 150 trucks)
  - Main categories of trucks
- Combined data
  - Statistics Norway's lorry surveys (2016 & 2017)
  - Norwegian Public Road Administration's Autosys register
    - Includes **technical information** about each vehicle

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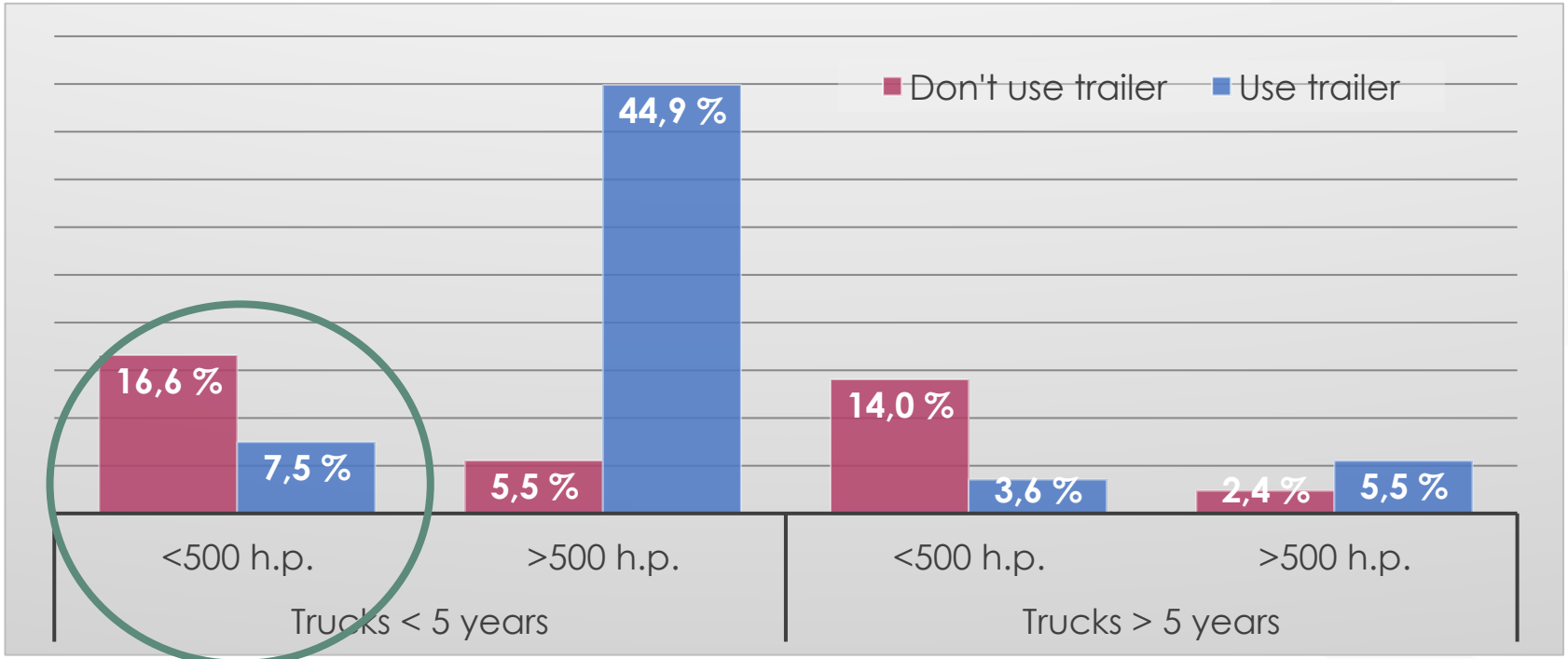
Vehicle segments with potential for early electrification



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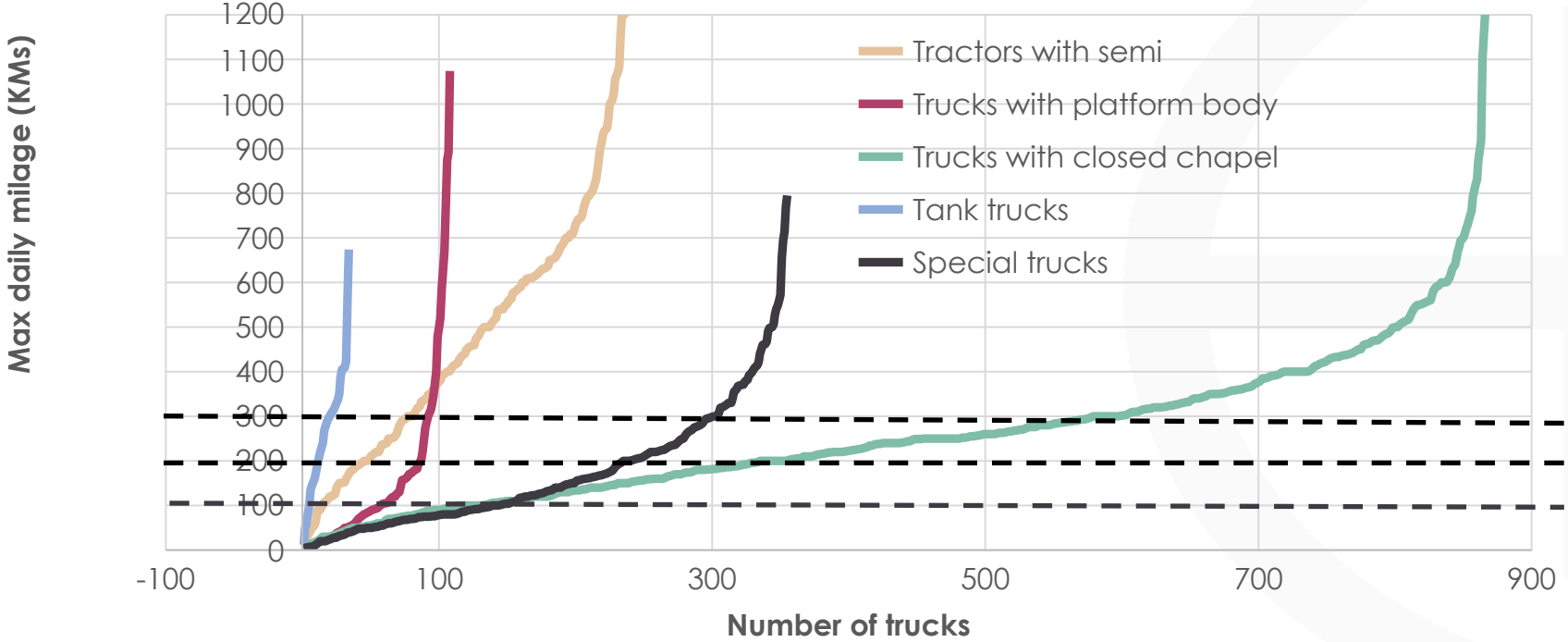
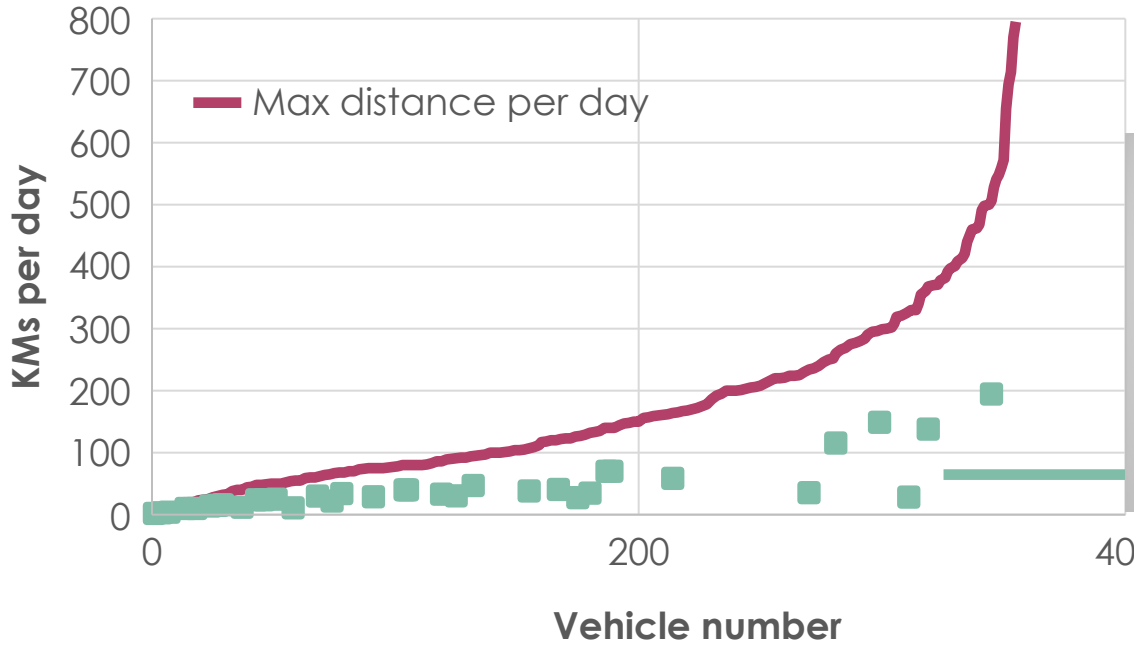
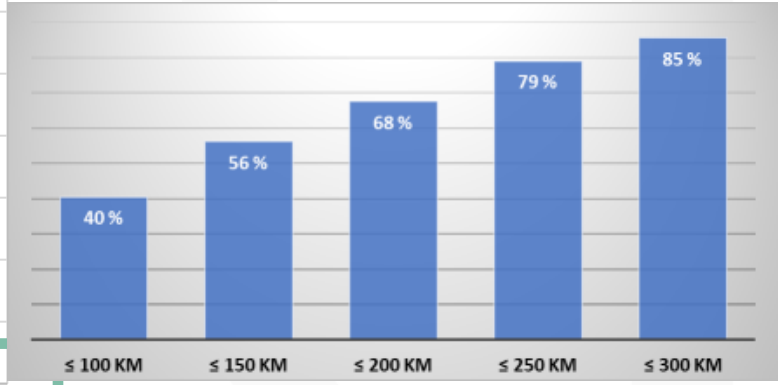
Special trucks and distribution trucks have most trucks in the potential electrification segment



Maximum daily mileage for **special trucks** (e.g. refuse collection trucks)

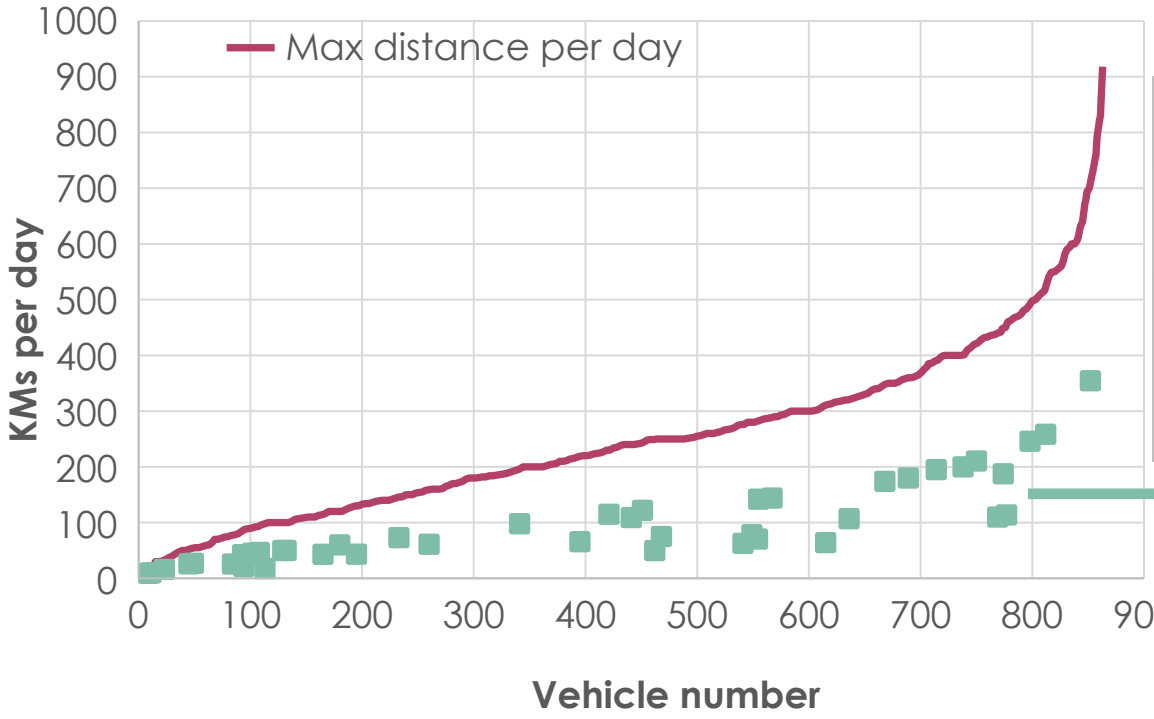


Share of vehicles with max daily mileage up to:

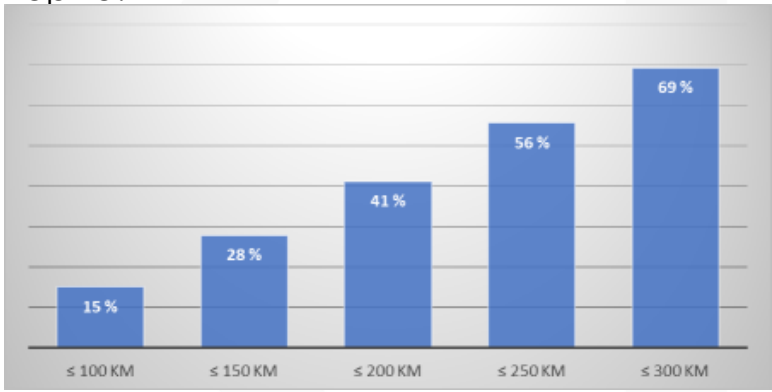


10 % have charging possibility

Maximum daily mileage for **trucks with closed chapel** (e.g. distribution trucks)



Share of vehicles with max daily mileage up to:



5 % have charging possibility

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- Costs of operations

Cost competitiveness of electric vs. ICE operation

Cost category	Main aspects taken into account		
Cqpitql costs	Investment/capital costs excl. subsidies	Depreciation, residual values and discount rate	
Distance dependent	Energy consumption & cost (base price + any levies)	Road toll charges and exemptions for zero-emission	Driving distances & mileages
Premium for charging	Upgraded power in the grid to the depot		

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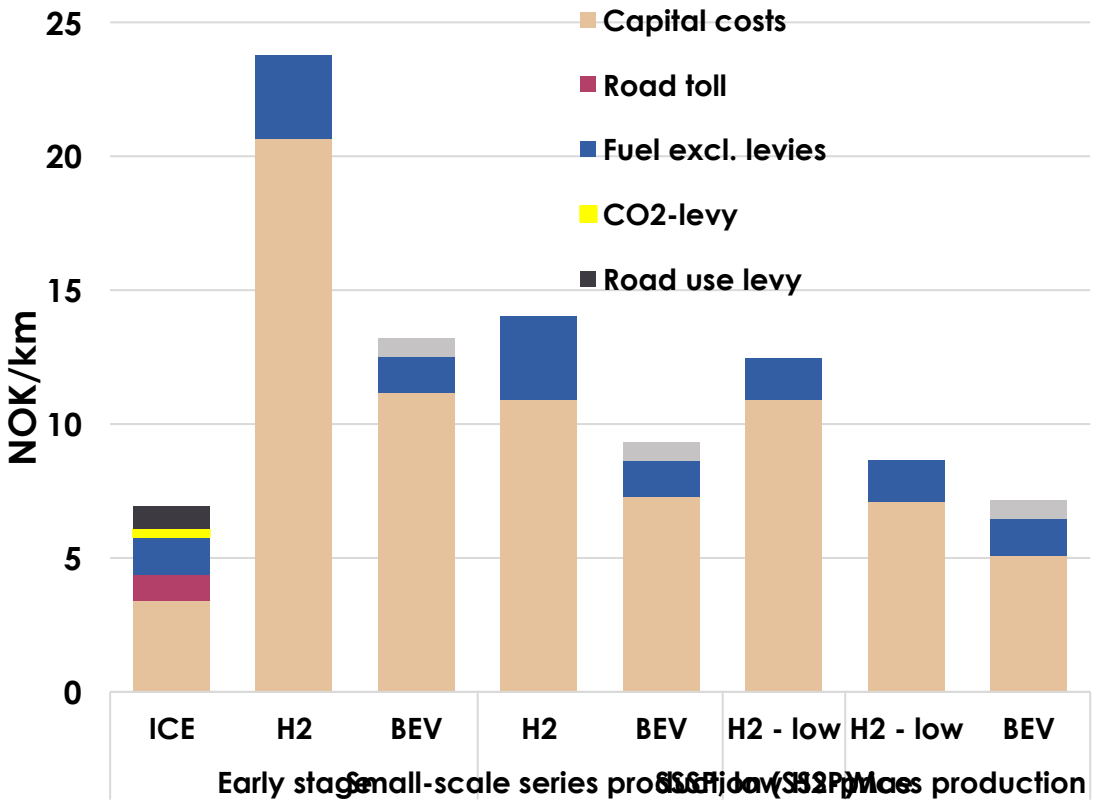
Ownership cost decomposition

Light distribution trucks (ICE, BEV and H2)

Four technological maturity scenarios.

Figures in NOK/km



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Annual mileages (km) required for battery-electric and hydrogen-electric light distribution trucks, respectively, to achieve costs of ownership lower than for ICE

	Early stage	Small-scale serial production (SSSP)	SSSP with low H2-prices	Mass production
Battery-electric	>180 000	>86 000 (regular charging) > 160 000 (given fast charging)		>20 000 (reg. charging) > 38 000 (fast charging)
Hydrogen-electric	Not competitive		>225 000	>93 000

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Thanks for your attention!

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