

Copenhagen trial with 12 m B.Y.D K9 electric buses

Movia tester

elbusser

Victor Hug Project Manager

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Movia's vehicle fleet



- 1,450 buses on 448 routes
- 60 trains on 10 routes
- 2,500 cars/650 minibuses with lift
- App. 220 million passengers annually
- App. 1 billion passenger kilometers annually
- Total operational cost DKK 3,065 million (EUR 411 million)

Environmental management

Ambitious goals

Very strict functional demands – greatest environmental effect per money spent

The environment is one of our most important "customer"

Maturing the marked

Reliability is paramount - nothing is second to our customers



Environmental targets

Udledningsmål for Movia - indekseret

Trafikplan 2013-2020



ANN: Miljøregnskabet er udarbejdet efter retningslinjenne i DNDS 16258 og er metodisk kvalitetssikret af Force Technology. Visse tal i miljøregnskabet bygger på et estimat. *1 | Trafikbestillergruppe: Region Hovedstaden, Københavns kommune, Frederiksberg kommune, Albertslund kommune, Glostrup kommune, Brandby kommune, Hvidovre kommune, Radovre kommune, Vallensbek kommune og isha j kommune

*2 | Trafikbestillergruppe: Øvrigekommuner og Region Sjælland

 Buses have huge potential for environmental improvements
 High mileage
 Used in city centers
 Impacting on many citizens

Expectations in 2009 for technological development in 2020

Euro 6 diesel, small diesel buses, diesel hybrids, electric buses

Expectations in 2015 for 2020

Diesel, small buses, biogas, BTL, electric buses – night charged and opportunity charged

Technical development is going fast and is difficult to predict

Trial with 12 m electric buses from BYD

Purpose of the trial

- To test feasibility of nightly charged electric buses in regular service. Buses replace two diesel buses in regular service
- Reduce CO2 emissions. The City of Copenhagen has a target of becoming CO2 neutral by 2025, and the funding scheme of the Danish Transport Authorities focus on reducing CO2 form transport
- Reduce NOx emissions
- Trial runs from January 2014 to December 2015

Budget

 Total budget of DKK 8.3M - funded by the Danish Transport Authorities (DKK 4.6M), the City of Copenhagen (DKK 2M) and co-financed by DONG Energy and Movia











B.Y.D. K9 specifications

- Length 12 m
- Gross Vehicle Weight 18 ton
- Unladen Vehicle Weight 13.9 ton
- Battery capacity 324 kWh
- Battery lifetime estimated 6-10 years (+80%)
- Top speed 70 km/h
- 0~30km/h = ≤9s
- 58 passengers (28 seats)
- Door configuration 2-2-0
- Charging time 4-5 Hours
- Charging power 2 x 30 kW



Key experiences

In light city traffic (line 12, 40 and 141/149)

- Average yearly consumption 1.29 kWh/km (1.15-1.41)
- Estimated range 130-360 km (average 260 km)
- Max test showed 325 km

In heavy city traffic (line 3A)

- Based on 9 month of data (Oct. 2014 July 2015)
- Average consumption 1.41 kWh/km (1.24-1.77)
- Estimated range 160-303 km (average 232 km)
- Max test showed 250 km



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Energy consumption propulsion and heating - Bus 2

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Cancelled operation days

Uptime (completed planned operation days)

• Bus 1: 59%, Bus 2: 64%

Bus 1

- Service and technical problems 62%
- Bus operator 16%
- Movia 22%

Bus 2

- Service and technical problems 50%
- Bus operator 24%
- Movia 26%





Main technical challenges resulting in cancelled operation days

- Diesel heater brakedown both vehicles (38 and 9 days)
- Power battery pack damaged due to unauthorized disassembly (31 days)
- Problems with charging of start battery (15 and 10 days)
- Motor coolant leakage (6 days)
- Difficulties with door closing (8 days)
- Problems with remote controlled key (5 days)



Other technical challenges

- High internal noise. Noise from the rear axel (70-73 dB(A) – some tests show noise level of up to 80.7 dB(A))
- Air compressor oil leakage
- VTOG parts reliability
- Turning radius (12 m)
- Signs difficult to change



Drivers' evaluation

- Some drivers prefer driving the e-bus and are very excited with the bus
- Others are not happy with it, reasons:
- Lower comfort
- > More noise
- Difficult to comply with the timetable







Customer feed-back

- 76% emphasize the bus as a good environmental friendly initiative
- 25% state that the bus is too noisy
- 20% hold that the bus is comfortable
- 16% stress that the bus is silent





Economy

- Price of B.Y.D. bus app. EUR 425.000.
 A diesel bus of similar size costs app. EUR 230.000
- Our calculations show that TCO for BYD bus is EUR 1.31 per km, where TCO of a similar diesel bus is EUR 1.01 per km
- This corresponds to 30 pct.
 higher costs for the electric bus



Thank you for your attention

Victor Hug vih@moviatrafik.dk





First experiences with electric buses

- 9 buses of 7 meters
- From 2009-2014
- Refurbished diesel buses
- Daily mileage: 140 km
- Many technical issues

Major learning points

- One supplier
- OEM-build buses



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