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TURKU UNIVERSITY OF
APPLIED SCIENCES



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European Union
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Driver and Staff Training in e-bus Deployment in Turku



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Short video about the Good Practice



#ebussed #eBus #renewableenergy

eBussed: E-bus training for the whole staff, separate eco-driving for drivers

<https://youtu.be/5XeRSAMSqCY>

General Facts

E-bus Pilot Info and Bus Specifications

E-Bus pilot

- Single bus line electrified in 2016
- System consists of 6 e-buses, 2 opportunity chargers, 6 depot chargers

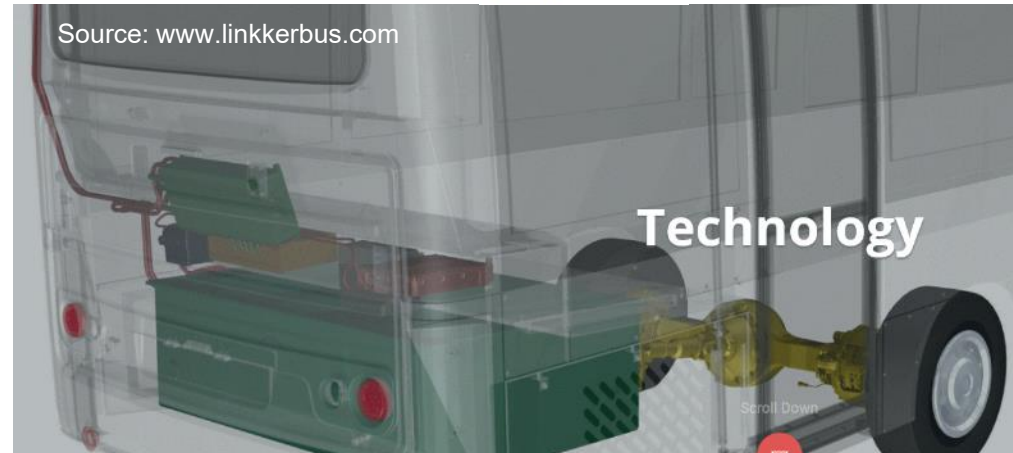
Linkker 13LE Electric Specifications

- Length 12.8 m
- Aluminium body, 10 100 kg
- Passenger capacity $36 + 42 = 80$
- Permanent magnet motor 180 kW



Linkker 13LE Electric Battery and Recharging

- LTO battery 55 kWh
 - Recharging power 300 kW
 - Driving range 35 – 50 km
- Opportunity Charging
 - Inverted pantograph
 - Both ends of line (12.5 km)
 - 3 – 5 min
- Depot charging
 - 22 kW / 50 kW
- High voltage also used for
 - Heat pump (15 kW / 15 kW)
 - Air Compressor
 - Power Steering
 - DC / DC (for 24 V)



Objectives of Staff Training

Facts Included in Training

- Benefits of the electric bus
- Familiarity with Linkker technology
- Operating and driving the eBus
- Charging the eBus
- Safety issues
- Solving problems



Driver Training

Driver Training

Basic Operation

- We started preparing for training by visiting the bus factory.
- Visits started early: at the first time only the chassis of the first bus was ready.
- We got training material, which we modified for our use
- We had also the opportunity to test drive the bus before it was registered.



Driving motor



Driver Training

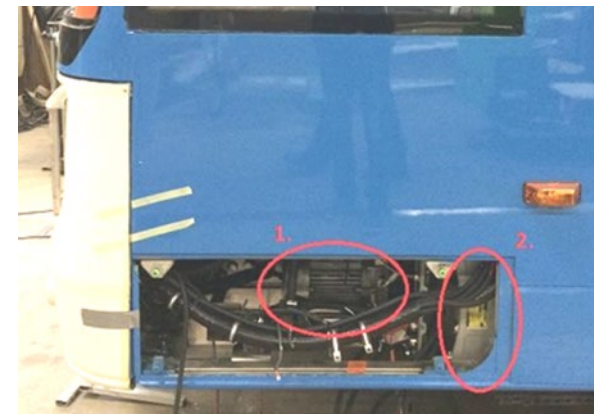
Basic Operation

- Location of switches and warning lights etc. in the instrument cluster
- Location of high-voltage components
- Location of high-voltage wiring
- Operation of heating and air-conditioning

Air compressor



Heating and air-conditioning



Power steering, inverter
and DC / DC converter

Driver Training

Practical Training

- Getting to know the bus generally
- How to drive the bus
- How to charge the bus (both pantograph and cable charging)
- Problem solving



Driver Training

Economical Driving

- Was organized after 6 months of operation
- Target group: about 100 drivers
- Morning part: theoretical training
- Afternoon: driving under supervision of the trainer
- Issues discussed:
 - Moderate speed (max 40 km/h)
 - Rapid accelerations
 - Mild and early decelerations
 - Anticipation: avoiding braking, maintaining the speed gained



Driver Training

Preparation for Eco-training



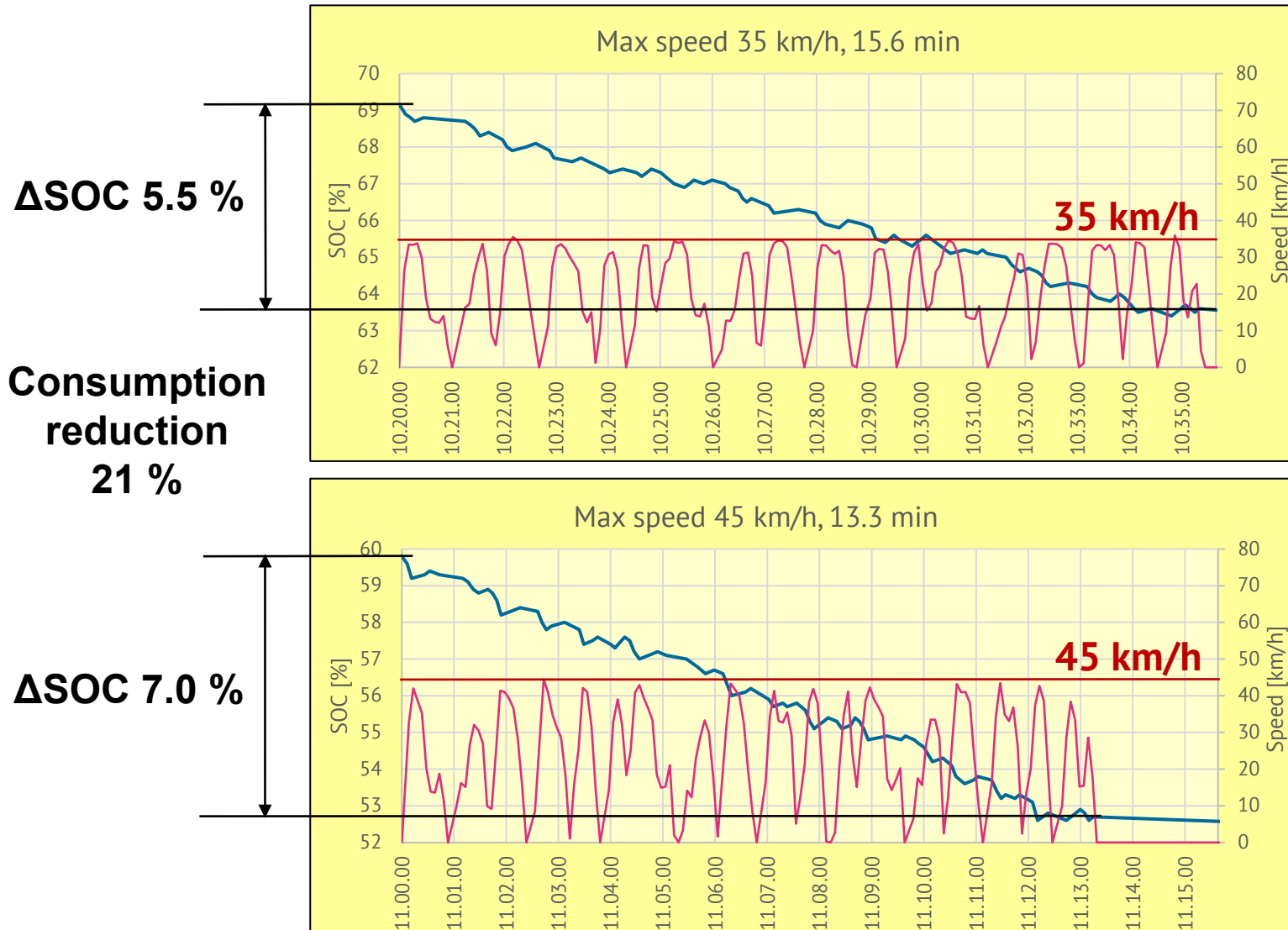
BUS LINE SIMULATION IN A RESTRICTED AREA WITH NO INTERFERING TRAFFIC

Comparison of electricity consumption using different driving styles

- 3 laps (3 x 1.8 km = 5.4 km)
- Stop of 30 sec at each Bus Stop
- Total of 16 stops

Driver Training

Preparation for Eco-training



Service Crew Training

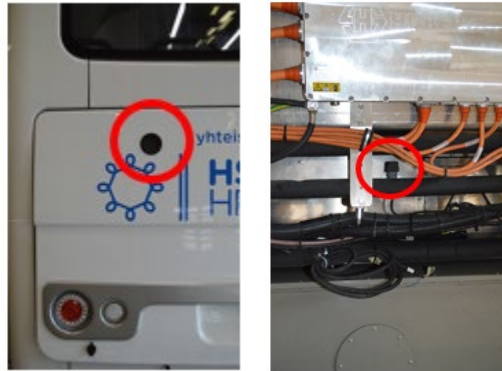
Service Crew Training

Bus and Charger Safety

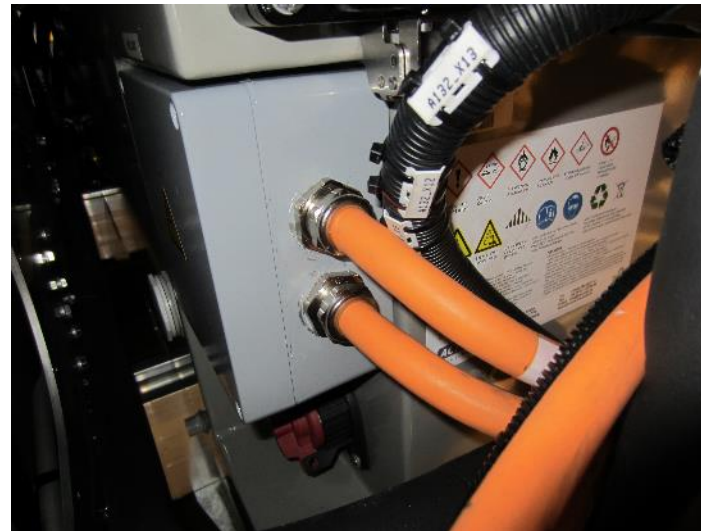
Emergency stop switches



Resetting the system after accident



High voltage powerlines



Rescue and Towing Staff Training

Rescue and Towing Staff Training

Abnormal Situations

- How to lead the passengers out
- Disconnecting the high-voltage battery
- Locations of high-voltage components and wiring
- Locations of the 24 V main switches
- Preconditioning the vehicle for towing
- Use of the towing hitch



Conclusions

Linkker 13LE Electric Bus

Conclusions

- The bus is energy-efficient, battery-to-wheel (~1 kWh/km)
 - Grid-to-wheel consumption 15% higher than battery-to-wheel
- Smooth ride (no gear changes)
- Low noise level
- Problems existed with the diesel powered interior heater
- Diesel powered heater was replaced by an electric heater => OK
- System reliability (bus and re-charging devices) below expectations



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Thank you!

