LCA OF AUTONOMOUS SHUTTLE BUSES IN PUBLIC TRANSPORTATION SYSTEMS

1. RESEARCH INTEREST

Initial situation
- Unknown environmental effects of autonomous shuttle buses in public transportation and implications for future mobility systems

Research objective
- Assessing impacts of autonomous shuttle buses in public transport systems

Background
- EU-funded project with NAVYA

Procedure (see figure 2)

2. METHODS & LIMITATIONS

Methods
- LCA using a mix of theoretical and primary data (see figure 2)
- Considered guidelines:
  - DIN EN ISO 14040
  - International Reference Life Cycle Data System (ILCD) handbook (IES, 2010)
  - eLCaR - Guidelines for the LCA of electric vehicles (Althaus et al. 2013)

- LCIA database Ecoinvent 3.5 in combination with Umberto LCA (see figure 3)

Limitations
- Data uncertainty (missing primary data, etc.)
- Usage data are mainly from test runs – Standard operation has not yet started

3. GOAL & SCOPE

- One passenger kilometres in short-distance traffic
- Production, assembly, use phase, End of Life (Cradle-to-grave)
- 21 most important components (>92% of total weight)
- Cut-off: 5% of autonomous components
- Europe
- 12–15 years of operation
- Climate Change, EP, AP, PODP, ADP, Ecotoxicity (Identified as most frequently used for relevant technologies)

4. SHUTTLE INVENTORY

AD + EV components
- Chassis, Bath, Arch
- Steering, Motor, Shock absorber, Variator, Battery
- Harness, AC, lights, Calcul Unit
- Panels, Screens, Seats
- Doors, Cabins, Ramp
- Tires & Wheels
- Autonomous Components

Adaptation
- Bus framework: Propulsion system
- Electronics, Interior
- Doors, cabin, ramp, Tire & wheels

5. USE PHASE

- 33 kWh LiFePO4 battery
- Min. 60,227 km life time
- 2.19 transported passengers/km
- ≤ 0.5 kWh energy consumption/km

6. PRELIMINARY RESULTS

Results
- Under discussion and not final yet

7. CONCLUSION & NEXT STEPS

Conclusion
- Contribution of AV technology to results is not that big
- Electricity mix is important
- Challenges are not very different to other vehicles
- Further research is required, e.g., effects of data transmission
- Usefulness of applying shuttle buses in public transport system

Next Steps
- How can autonomous buses replace motorized individual transport?
- Ecological advantages are only when autonomous shuttle buses will replace privately owned vehicles

LITERATURE

- Althaus et al. 2013.
- Avenue Project. N.n.
- Deutsches Institut für Normung e.V. 2006.
- Ecoinvent, database ecoinvent 3.5.
- Gawron et al. 2018.
- International AB. 2018.

- Nagra &做法

Further information: https://h2020-avenue.eu