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REPLICATION DAY, TAMPERE
MARKO PAAKKINEN / VTT

Shared charging of e-buses and municipal vehicles
Challenges

- Shifting to electric buses requires charging infrastructure
- Possibilities
  - Depot charging => large batteries
    => high energy need at depot
  - Opportunity (fast) charging => smaller batteries
    => high power need at stops or terminals
- Best choice is depending on use case and location
- Combination of depot and opportunity charging can be also used (example Leppävaara bus terminal)
Lessons learned from e-bus projects

- Single charging points serving light bus lines at end stops are not feasible
  - Low utilization => poor energy efficiency
- Bus terminals or similar locations are preferred
  - Higher utilization => lower CAPEX
- Even with high utilization (typically during rush hours), there typically is excess charging capacity

⇒ This capacity could be shared!
Obstacles for rapid deployment of urban ECV’s

- Insufficient choice of electric commercial vehicles available at the market
- Operational and business concepts are still under development
- Current commercial e-vehicles have high CAPEX
  - New technology
  - HD vehicles mainly have large batteries, designed for overnight charging
- Insufficient charging infrastructure (for ECV’s)

⇒ Hmmm, I think that we are up to something here…. 
Siloing is not cost efficient
Alternative option: shared infrastructure

Shared charging networks

- City fast chargers (300 kW+)
- Loading docks (50 kW+)
- Public chargers (50 kW)

Proprietary chargers

- Operator depots

Electric buses

- Bus
  - Small to medium battery

Electric trucks

- Truck
  - Small to medium battery

Electric vans / Taxis

- Van / taxi
  - Medium to large battery

Municipal vehicles

- Vehicle
  - Small battery
  - Range extender

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 731297.
mySMARTLife shared charging demonstration
One e-bus fast charger will be equipped with an external charging connection:
- Cooled cable, maximum current 500A
- Allows 300 kW charging @600V

Prioritization:
- If a bus is charging => external charging is not allowed
  - Bus charging time typically 4-5 min
- If external charging is active and bus arrives => external charging is paused until bus charging is finished

Hopefully working in spring 2020!
Based on VTT Smart eFleet simulation of a full day with maximum number of buses on line 51
(18 km line, 15 buses, 127 kWh battery, 60 s charging dead time)
Exemplary use in Hakaniemi

Priority for e-buses

External users

Charger availability

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Related projects (spin-offs from mySMARTLife)

- Silent Refuse Truck
  - Smart Otaniemi ecosystem, funding Business Finland
  - Coordinated by VTT (pekka.rahkola@vtt.fi)
  - Evaluating the use case for fast charging and silent refuse truck
- eRetrofit
  - Funded by Helsinki city innovation fund
  - Coordinated by Forum Virium Helsinki (shabnam.farahmand@forumvirium.fi)
  - Retrofitting a Stara diesel truck to electric powertrain
  - Both using the Hakaniemi shared charger in pilot phase

Photo: Ruska Tapiovaara / Forum Virium Helsinki
Scale-up plan
Future vision - shared charging arrangement with dynamic power allocation and prioritization

Modular chargers (600 kW+)

Dynamic power allocation between outputs

Charging prioritization

E-bus charging point 1
E-bus charging point 2
E-bus charging point 3
E-bus charging point 4

External charging cables (CCS Combo connector)

Electric delivery trucks
Photo: Niinivirta European Cargo Oy

Electric / hybrid municipal vehicles
Photo: Vilakone Oy

Electric refuse trucks
Photo: Phoenix Danmark
Continuation to HSL’s ePELI e-bus pilot project
EIB / ELENA funded, 4 years
Started in January 2020
Assists in scaling up the HSL region e-bus operation
- minimum 650 e-buses operating by 2025
Aim for shared charging infrastructure, where feasible
Coordinated by HSL with a project manager from VTT
- Tommi Muona - tommi.muona@vtt.fi
Conclusions

- ECV’s require dedicated charging infrastructure to ensure availability
- Shared charging infrastructure can save CAPEX in chargers, but also in vehicles
- Sharing also improves energy efficiency
- Sharing can boost the adoption of new e-vehicle classes
- Depending on location and use case, sharing could be done also with passenger cars
Thank you for your attention!

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