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Swiss Competence Center for Energy Research
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In cooperation with the CTI
Energy funding programme
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Confédération suisse
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Swiss Confederation
Commission for Technology and Innovation CTI

SwissTrolley plus: R&D on battery lifespan

Within the project «SwissTrolley plus», Carrosserie HESS AG is developing a new type of trolley bus together with Verkehrsbetriebe Zürich (VBZ), ETH Zurich and Bern University of Applied Sciences (BFH). The novelty of this trolley bus is given by its propulsion system which includes a traction battery that replaces the auxiliary power unit of the conventional trolley bus. The high-power traction battery offers several advantages: (a) The battery can store the braking energy gained by recuperation and thus reduce the total energy consumption of the vehicle. (b) The battery-assisted trolley bus is able to drive for routes without any catenary lines, reducing infrastructure installation and maintenance costs. (c) By using the battery as an electric buffer, the EMS of the vehicle will be able to reduce peak loads on the electric grid.

The activities in this project are suported by the SFOE through ist research and flagship programmes.

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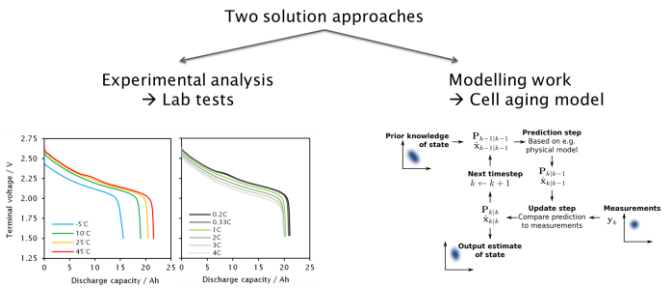
Work at BFH

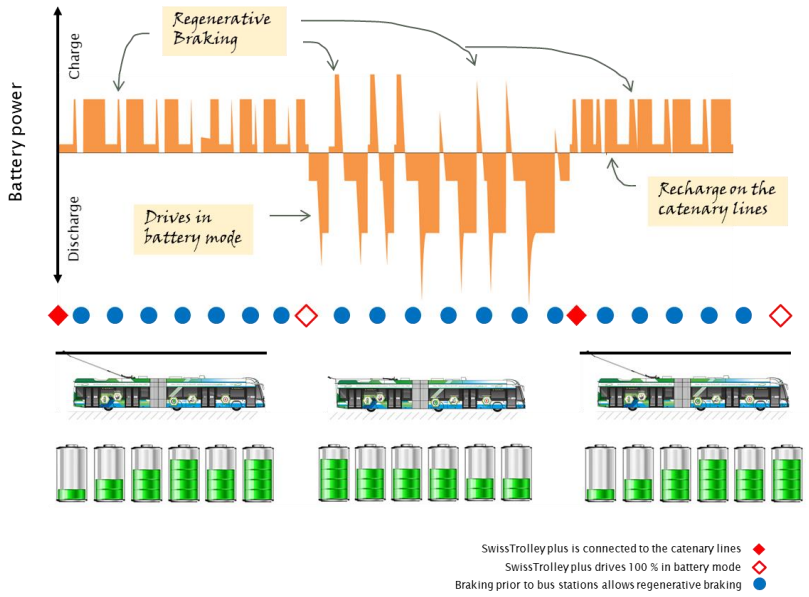
The goal of BFH-TI is to develop tools that guarantee a desired minimum battery lifespan and that define the most suitable operation regions of the battery in order to maximize the battery life.

Main R&D questions:

(1) what is the influence of different usage conditions on the battery lifetime?

(2) how can we accurately predict the cumulative effect of different usage conditions on battery performance over time?





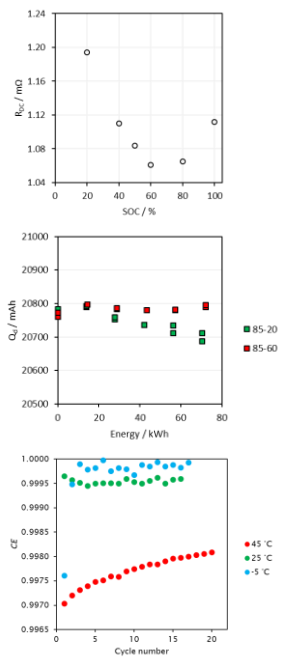
Optimal lifetime-conscious battery operation

- The battery is held within a specific State of Charge window to guarantee sufficient energy for drives without catenary lines and enable charging through regenerative braking.
- Regenerative braking allows recharging of the battery during downhill drives and braking before every bus station and increases the overall energy efficiency of the system compared to conventional trolleybuses
- The battery supports the DC grid
- The battery is recharged on the catenary lines

Battery lifespan

Batteries die because of the existence of unwanted parasitic reactions in the insides of the cells. The rate at which these parasitic reactions occur depend on several factors such as

- Physico-chemical properties of materials
- Cell architecture
- Battery pack and system architecture
- Battery pack interconnection
- Battery size
- Operating conditions
  - Temperature (T)
  - Voltage during operation (U)
    - State of charge during storage (SOC)
    - Depth of discharge (DOD) at diff. SOC levels
  - Charge and discharge current (C-rate)



Expected impact

The goals of the project are the following:

- Reduction of noise and pollutant emissions
- Increased energy efficiency by a novel power and energy management
- Drives without overhead wires are possible
- Support of overhead DC-grid by battery is possible
- Maintenance cost savings by not utilizing the overhead wire network
- Guaranteed battery life of > 10 years by conscious battery utilization

From an economic point of view, battery lifetime (or battery lifespan) is one of the most important factors when considering the user's return on investment (ROI).

References

Visit:
www.swisstrolleyplus.ch
www.bfh.ch/energy

Partners

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