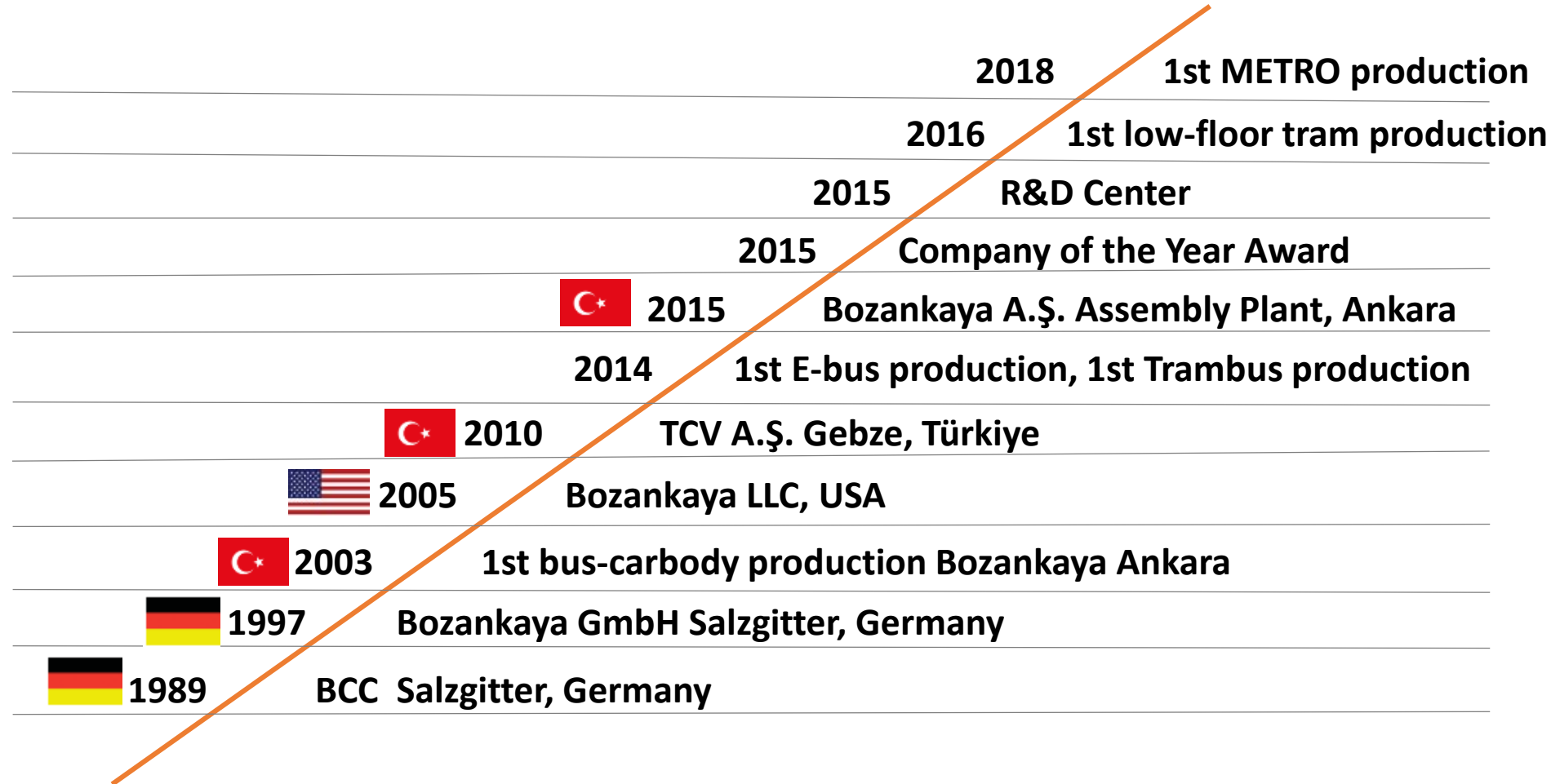




ELECTRIC COMMERCIAL VEHICLES & RAILWAY SYSTEMS



History



Capacity

- More than 50M EUR investment to create Turkey's biggest and most modern railway systems production facility
- Located in the 1st Organized Industrial Zone near Ankara - the most suitable production area with the best infrastructure
- Modern production technology (Welding robots, testing equipment)
- Eleven production lines inside the facility to realize all kinds of railway projects efficiently
- Capacity of 288 railway vehicles per year.

100.000m2
Production
facility

288
Metro Cars
Per Year

~1000 employees
~150 engineers

Turkey's biggest
Railway business
paintshop



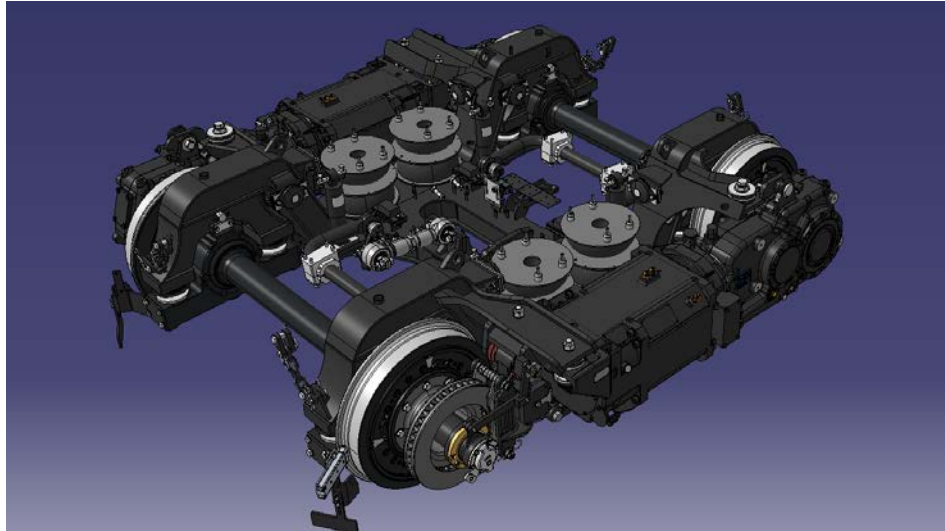
Kayseri Tram Project

- Kayseri/Turkey tram tender won in 2014
- Design & production of bi-directional **31 trams**
- **First commercialization of Bozankaya's proprietary 100% low-floor bogie and vehicle design**
- **Combines passenger comfort with maximum safety**
 - No steps in passenger compartment
 - Low noise level
 - Full air conditioning
 - Bogies and carbodies tested/certified in Czech Republic
 - Bogies with classic whelsets
 - All key components from first-class European manufacturers
 - Low axle load
 - One inverter for each motor
- **Emergency catenary-free 50m ride with on-board 24V DC batteries.**



Kayseri Tram Project

- 30 engineers, and over 150.000 engineering hours in total.
- First tram was rolled out of the factory in just 21 months after NTP
- Deliveries were completed in just 36 months.



Bangkok Green Line Project

- In a consortium with Siemens Mobility, Bozankaya won the contract to supply 22 metro trains, each consisting of four cars, in 2016.
- EUR50m investment in what is now Turkey's largest and most modern railways system production facility with a total 100.000m2 production space, integrating its proprietary technology with its partner's world-class components.
- **Developed the complete new interior design.**
- All production steps **from car body production up to static commissioning.**
- The first metro train rolled out of the Bozankaya factory just **25 months** after signing the contract.



Bangkok Blue Line Project

- Delivering 105 car bodies to Siemens Mobility, for a new customer in Thailand
- The scope of Bozankaya is expected to be extended for further responsibilities.



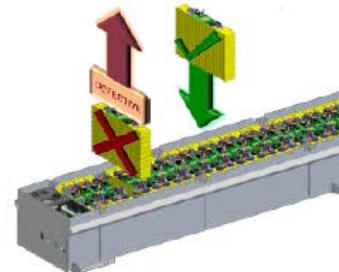
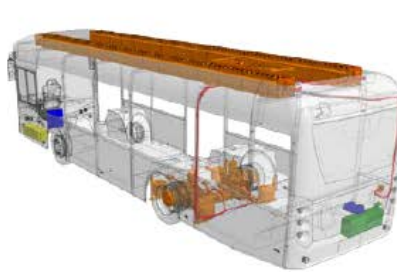
Experience

SILEO electric bus is a 100% electric, environmentally friendly, low-noise bus for municipal transport. Four different versions, with a length of 10 m, 12 m, 18m or 25m respectively, offer a passenger capacity of 75 to 232 persons. A 100% low floor ensures quick passenger pick up and drop off. Their electrical drives help protect the microclimate, lower harmful emissions, reduce noise levels in cities, and meet the European Union's strict air pollution standards.

SILEO recuperates up to 75% of its brake energy, which increases the bus's range significantly. On average, SILEO consumes 0.8 kWh/km under ordinary operating conditions.

High technology Bozankaya SCL battery system allows up to **300km range** with a single charge, low energy consumption and long battery life.

Two motors on axle leads to high output without transmission.



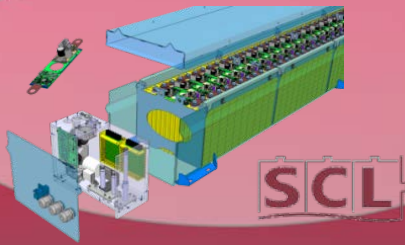
Timișoara Tram Project

PARAMETER EXPLANATION	VALUE
Number of vehicles will be supplied	16+24
Contract Size	33 m€ + 49,5 M€
Delivery of the first tram	in 18 months
Catenary free driving	> 60 km
Track gauge	1435 mm
Vehicle width	2400 mm
Total length of a tram	29900 mm
Number of double-leaf doors	4
Minimum horizontal curve radius	18 m
Maximum gradient	9%
Total passengers (AW3)	200
Seated passengers	46
Axle load at AW3	≤ 10000 kg
Door threshold height	320 mm
Axle configuration	BO'2'BO
Module configuration	MC-SA-T-SB-M
Driving direction	Uni-directional



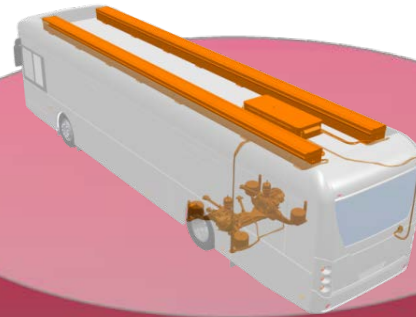
Sileo-Concept

The Sileo concept is characterized by a comprehensive safety concept, the unprecedented efficiency of the drive as well as the scalability of the loading technology..



SAFETY

- highest possible cell safety due to optimal choice of battery type
- extensive cell monitoring by the BMS
- Safety through redundancy: continued operation of the vehicle with one battery possible



EFFICIENCY

- powerful battery electric drive
- technically best possible implemented recuperation system
- Range corresponding to the requirements of all-day operation



SCALABILITY

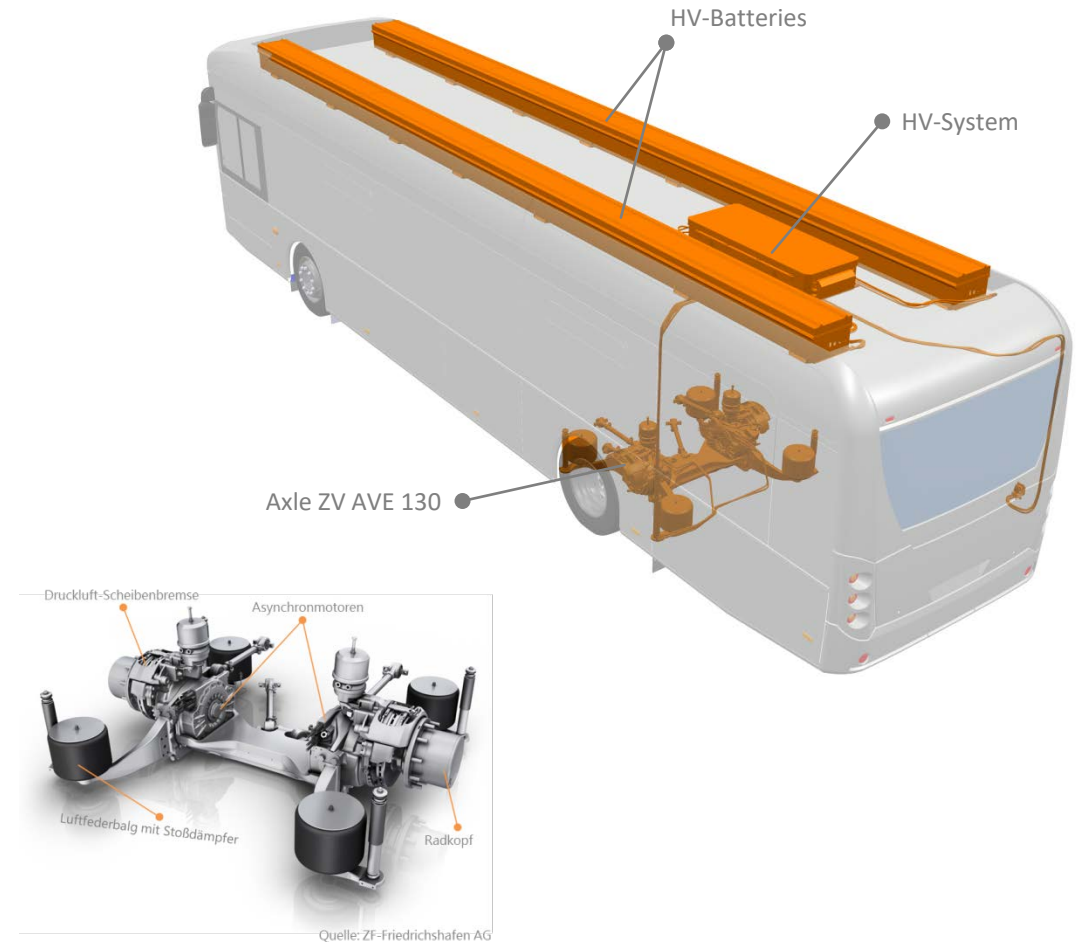
Extensive integration of loading technology into the fleet management of large vehicle fleets (Dynamic Loading Matrix - DLM)

Bozankaya SCL Battery System

Sileo-Powertrain

The drive system consists of the traction batteries, the HV system and the drive axle. High-voltage batteries, auxiliary units and HV system are manufacturer-specific components of the Bozankaya Group.

- The HV system consists of a driveline converter, on-board converter, drive control, and filter systems.
- Electric portal axle ZF AVE 130: two asynchronous electric motors close to the wheel with a peak power of 120 kW each and a torque of 10.5 kNm each.
- Two independent drive systems: if one drive component fails, operation can be maintained by the remaining circuit.

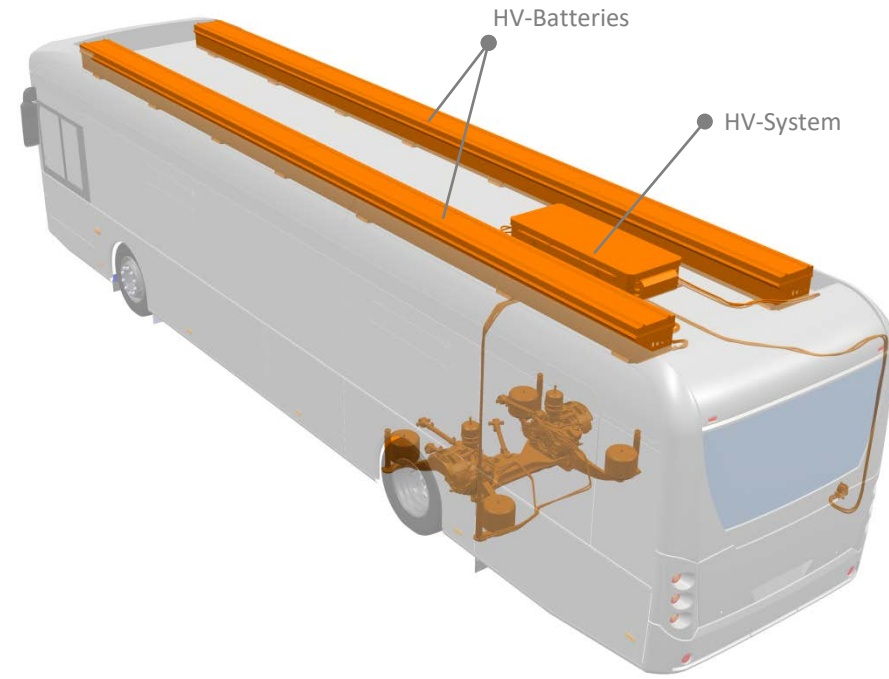


Bozankaya SCL Battery System

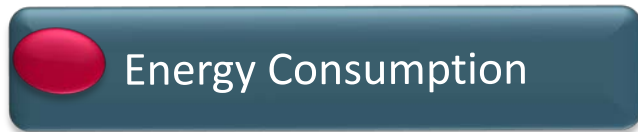
Sileo-Powertrain

All batteries mounted on the roof
Passengers seperated from HV
LFP batteries don't react with oxygene

- Inside vehicle only 24v bord net
- HV cables only to combo2 plug and axle(s)
- Seperated by contactor



Bozankaya SCL Battery System



The process of recuperation, i.e. the recovery of electrical energy in the generator mode of the drive motors, is one of the essential efficiency principles of the Sileo.

Integrated in EBS3 from Wabco

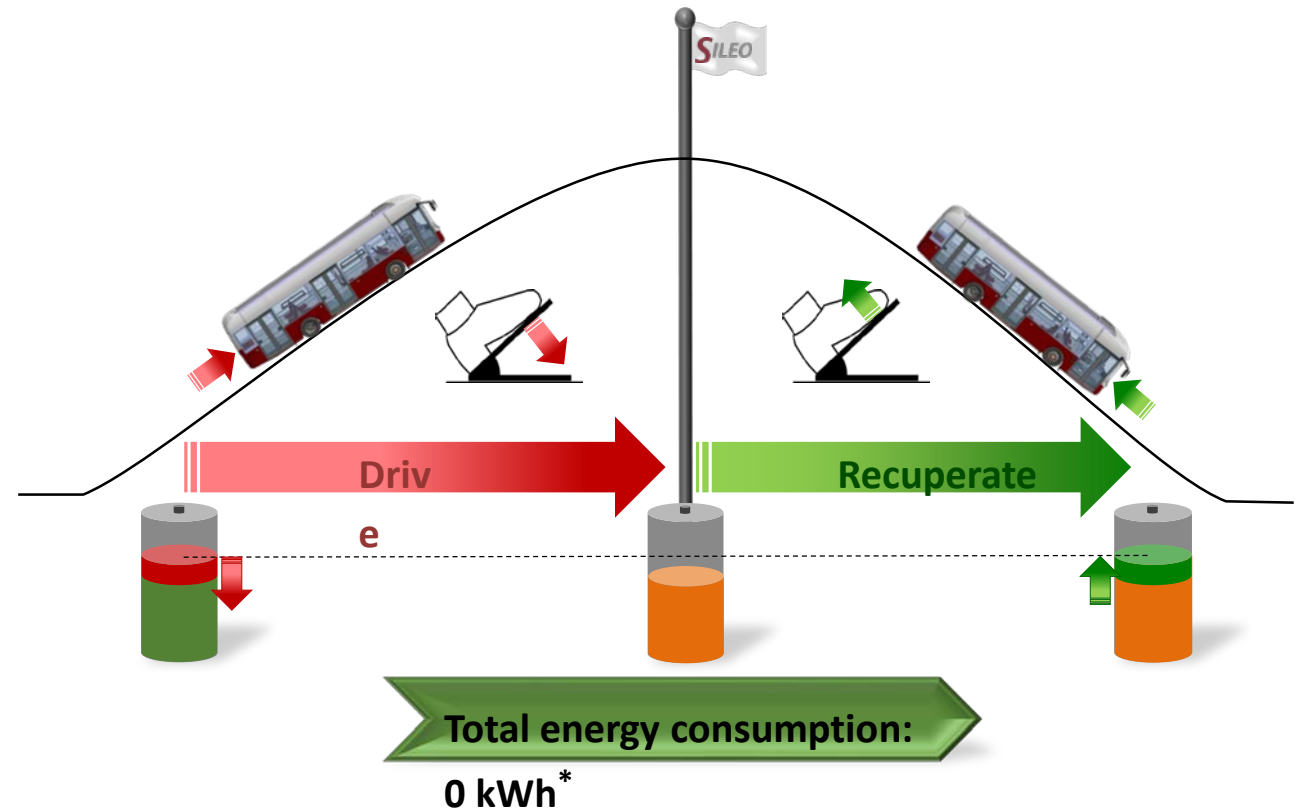
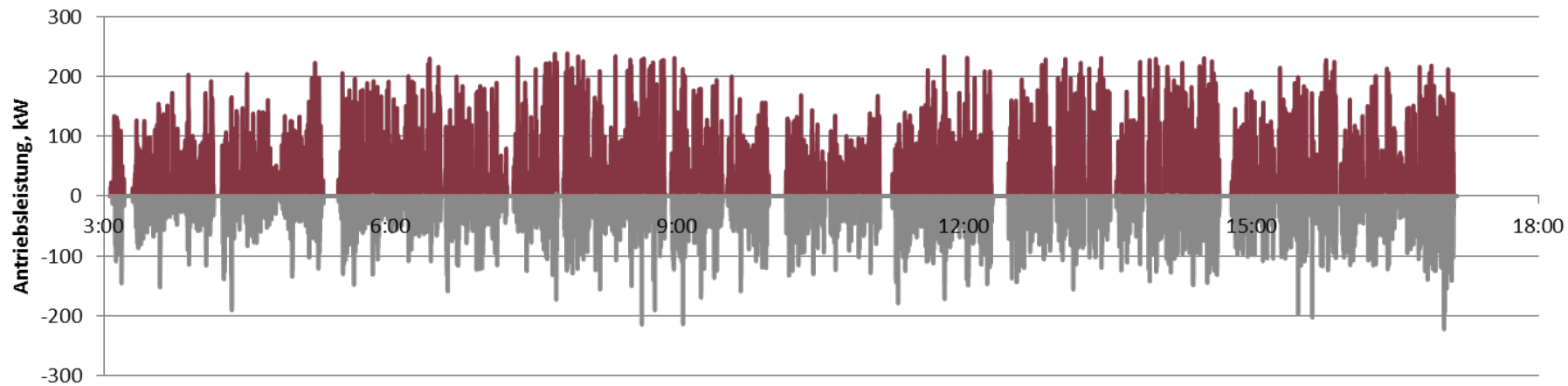
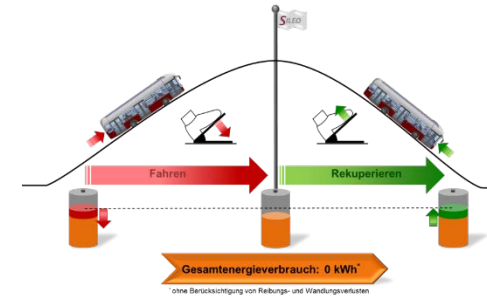


Illustration of the basic principle of recuperation

Bozankaya SCL Battery System



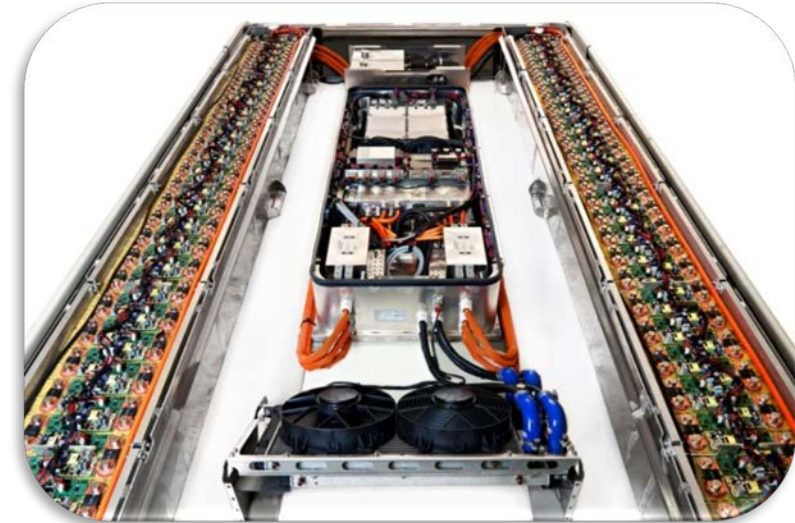
Total Energy Consumption: 195 kWh
Recuperation : 41%

Real data on the drive power in line use (red: drive, gray: recuperation)

Bozankaya SCL Battery System

BOZANKAYA Batterie System (SCL)

Rechargeable energy storage device with an intelligent self-regulating battery management system based on single cell monitoring for mobile use in buses and tramways.



Open BBS battery and HV system on the vehicle roof bus.

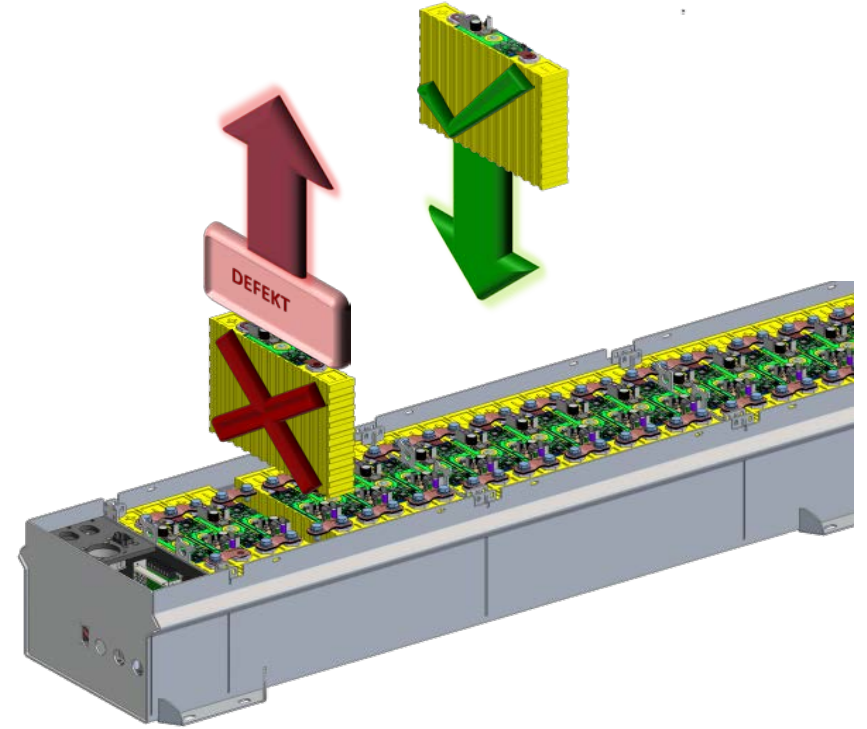
- Accommodation in a touch-proof and weather-protected, accident-proof aluminum housing on the vehicle roof
- Realization of an active balancing (optimization of efficiency and service life)
- comprehensive safety concept (continuous monitoring of safety-relevant limit values)
- **Smooth charge $\leq 1C$**

Bozankaya SCL Battery System

Cell

- Chemistry: Lithium iron phosphate (LiFePO₄)
- voltage: 2,5 - 3,65 V
- Capacity: 240 Ah
- Energy density: 134 Wh/kg

- high degree of intrinsic safety: fire and explosive behavior electrochemically excluded
- Replacement of individual cells possible: Minimization of downtimes and repair costs

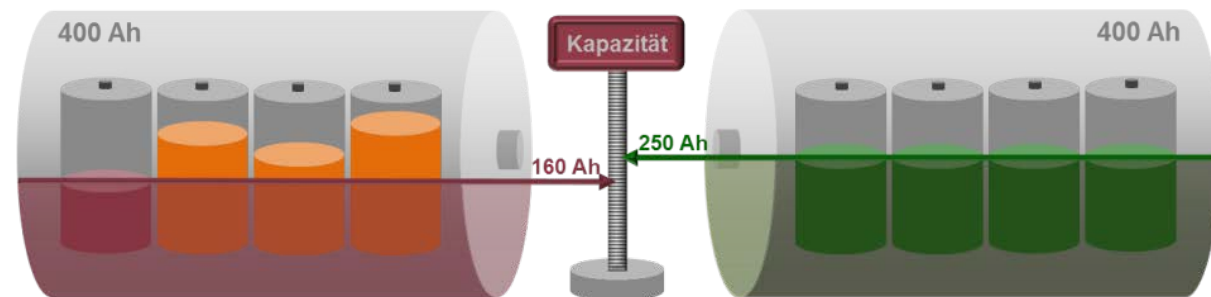


Bozankaya SCL Battery System

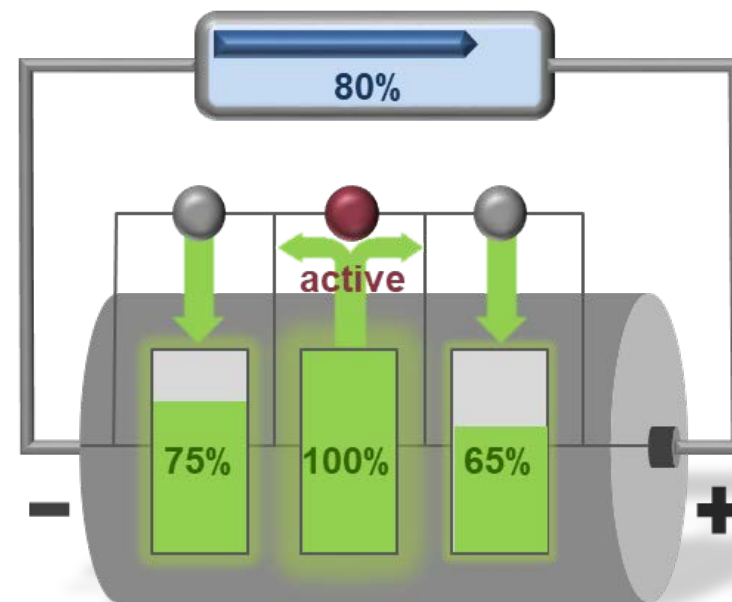
(SCL)-Active Balancing

After the widest possible DC charging of the cells connected in series, the balancing process takes place, in which each individual cell in the system is standardized.

- Equal level of current
- Active balancing

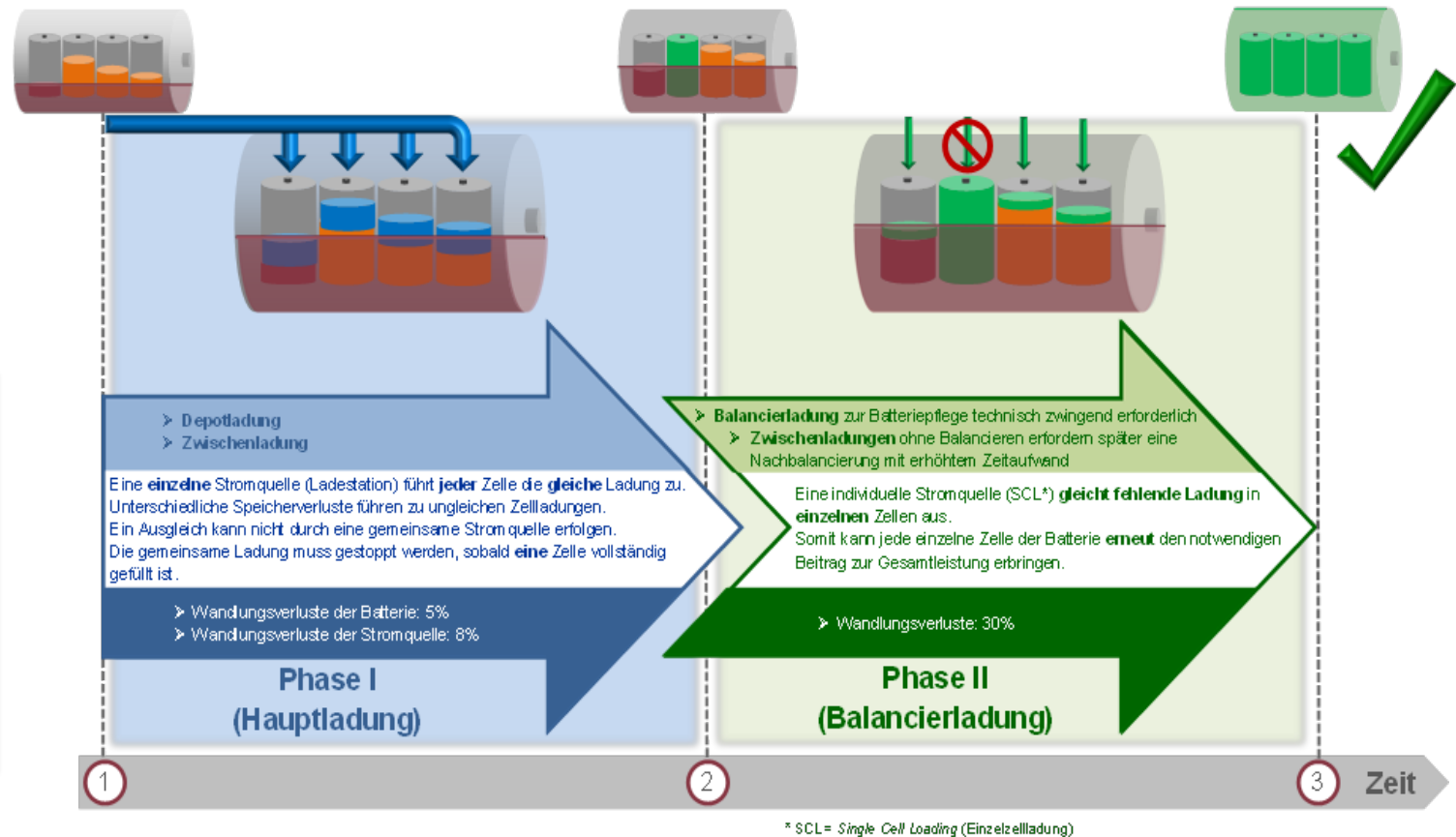


Schematic representation of the relationship between cell balancing and total usable capacity



Active Balancing

- complete cell balancing **prevents damage** as a result of **overcharging and deep discharge**
- Balancing ensures **maximum total battery usable capacity**
- the active form of balancing also enables **maximum energy efficiency and system service life**



Bozankaya SCL Battery System

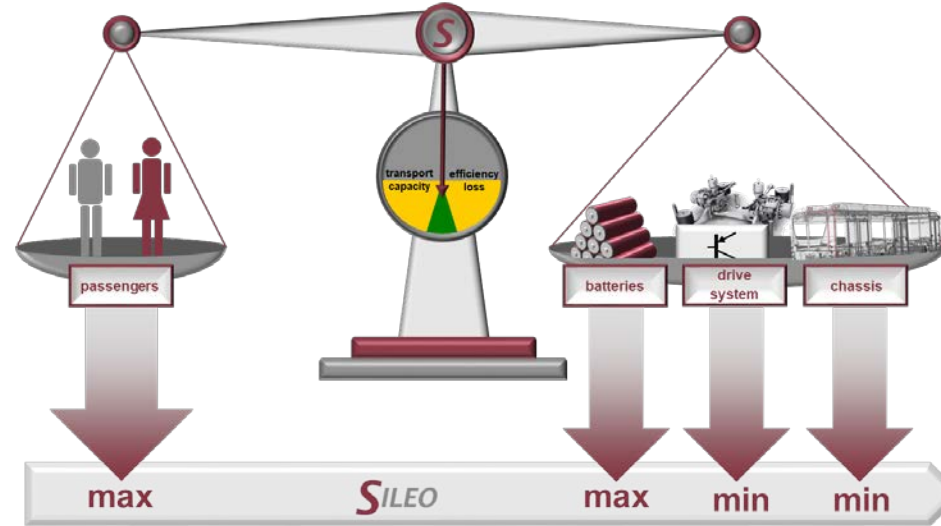

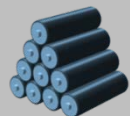


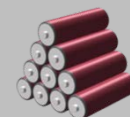
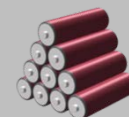



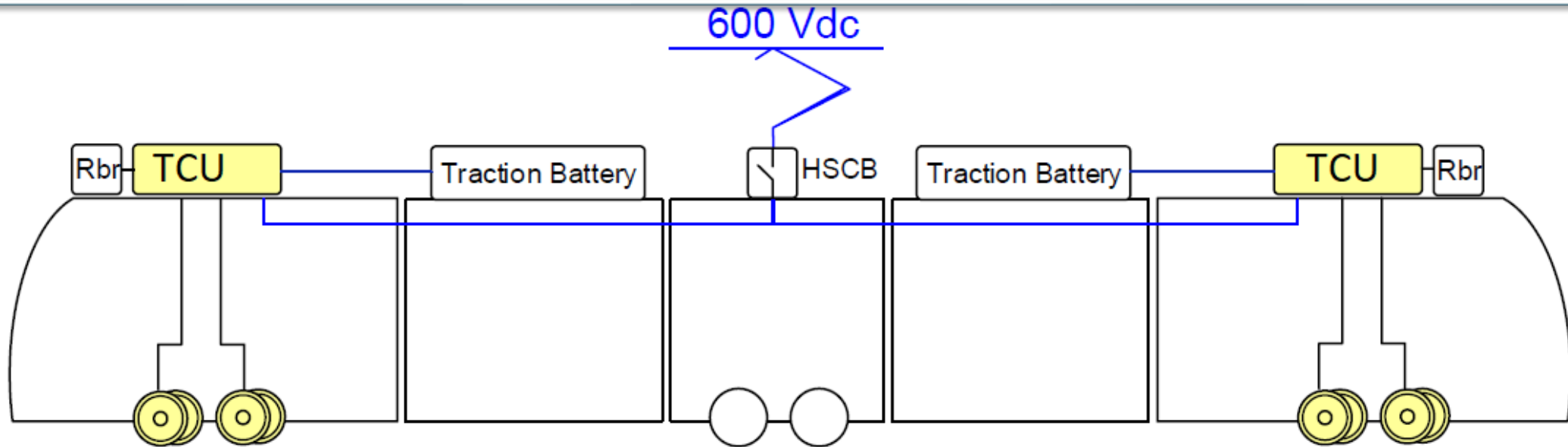
Illustration of the relationship between passenger numbers (transport capacity) and battery capacity (conversion efficiency).)

capacity	Battery	Power Electronics
 80		
 80		 

➤ The fully battery-powered Sileo bus is characterized by the highest possible capacity of the traction batteries with weight-optimised performance electronics.

➤ Positive effects on range, service life and efficiency

- **Bozankaya SCL Battery System** builds upon Bozankaya's years of experience with energy storage systems. The system combines high power capacity battery with long life and high reliability and has been designed to maximize performance using the latest developments in Li-ion cells.



SCL TRAMWAY APPLICATION

- Bozankaya SCL Battery System . Each unit comprises two battery packs and two battery management systems, and offers 166 kWh of capacity with a nominal voltage of 600 V.
- For a five-car tram, two battery pack managed by BMS-M are installed.
- Each battery pack managed by BMS-M has its own thermal conditioning unit, wiring harness and connectors.
- The advanced Bozankaya thermal conditioning unit maintains the battery's ideal temperature and enables rapid charging and full braking energy recovery while extending their lifetime to up to ten years.

