Driver Advisory Systems for punctuality, energy saving **… and range extension!**

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ERESS DAS day
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Agenda

1. Which trains benefit the most from Driver Advisory Systems?
2. Range extension & TCO considerations for alternative energy systems
3. Take-aways

INTERN

01

Which trains benefit the most from a Driver Advisory System?

Which trains benefit most from a Driver Advisory System ?

Various types of trains can benefit from Driver Advisory System, particularly trains that operate on complex and dynamic rail networks.

- Passenger & freight trains operating in a **difficult geographical environment** with mountainous or hilly terrain
- **Regional and commuter trains** serving suburban and commuter routes with multiple stops and tight schedules

- Trains with high energy consumption such as **high-speed trains** or **freight trains**
- Trains operating on **mixed traffic corridors** to ensure smooth and safe operations

- **Long-distance and intercity trains** traveling long distances with diverse track conditions and operational challenges
- Trains running with **alternative power sources** such as **batteries and/or hydrogen**

Alstom green mobility solutions for non-electrified railways

As the pioneer in sustainable mobility, Alstom has developed a wide range of green and innovative technologies to eliminate CO_2 emissions and pollution in catenary-free operation

DAS enables extension of the operational range for BEMU and FCMU trains

Battery (BEMU / Battery power car)

- Current range of **up to 120 km on batteries**
- Suited for **catenary-free operations** with **recharging** in electrified sections and stations
- **Kinetic energy recovery** during braking

Hydrogen (FCMU / Hydrogen power car)

- Current range **up to 1000 km**
- **Performance equivalent to diesel trains**
- **Kinetic energy recovery** during braking
- **Hydrogen refueling station** required

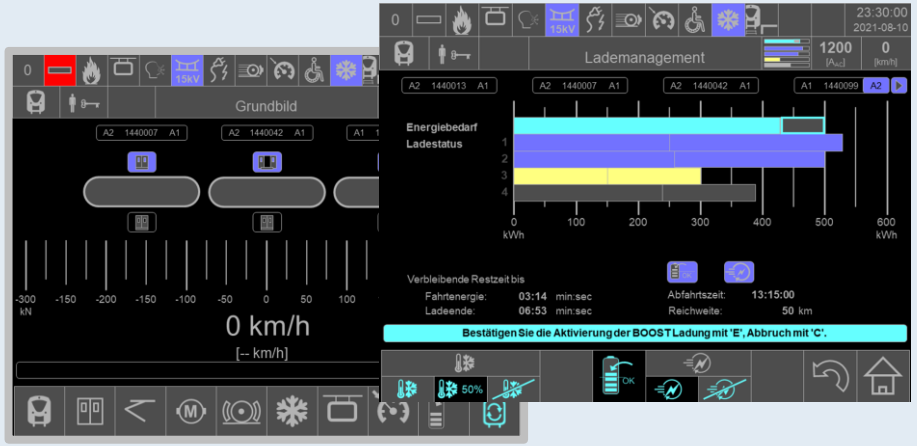
02

Range extension & TCO reduction for alternative traction systems

Example: Coradia Continental™ BEMU: DAS functions connected to train control

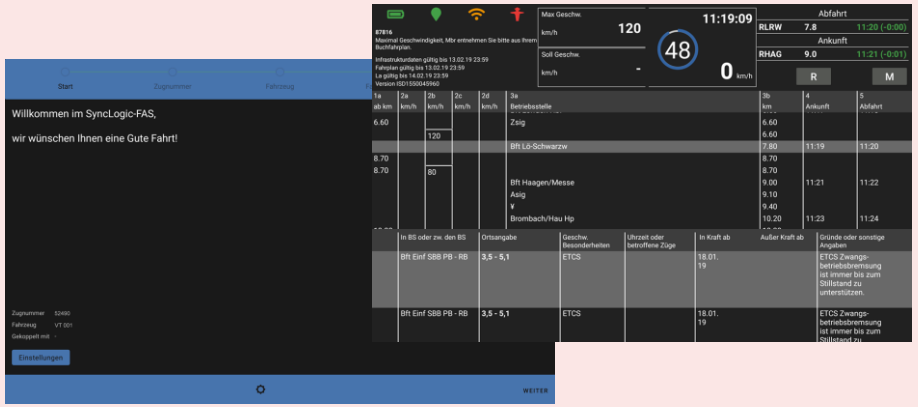
TCMS DMI including energy and change management

- Battery health and charging status
- Charging control
- Selection of charging modes
- Autonomy range indication



DAS Display

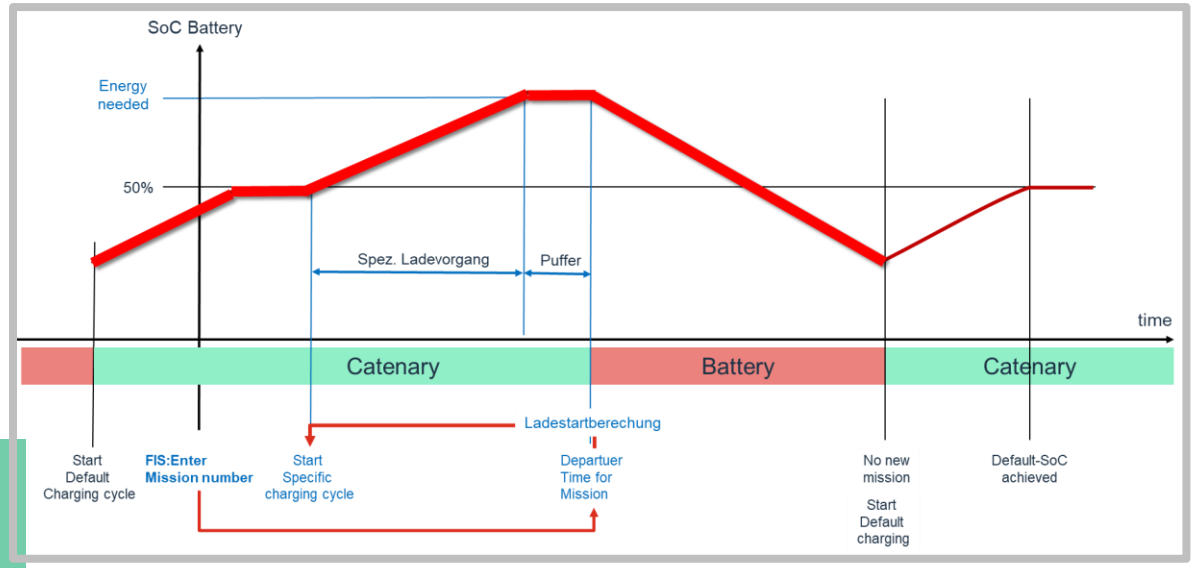
- EBuLa-Functions*, incl. “Green Functions”
- GPS location
- Realtime mission timetable
- Advice for energy-optimsed driving style



*EBuLa, Elektronischer Buchfahrplan und Verzeichnis der Langsamfahrstellen

Example: Battery operation charging strategy

- **Before leaving catenary section, available energy from traction battery needs to fit battery mission**
- **Charging modes are selected predictively to reduce battery stress and aging, for long battery life**



Actual state of charge,
Section/next station location
=> Calculate energy needed
=> Calculate charging time

charge

Battery sufficiently charged

Release for battery section

Catenary | Battery operation | Catenary

Range extension with Driver Advisory Systems

Energy savings that translate into potential range extension and cost savings

- Track characteristics: flat
- Stations: 6
- Distance: 30 km (one way)
- Duration: 26.9 min and 31.7 min

	Nominal	With DAS
Traction energy	134 kWh	94 kWh
Energy recovery	-26 kWh	-15 kWh
Energy for auxiliary system	22 kWh	26 kWh
Total energy need	130 kWh	105 kWh

19% of energy available for range extension

✓ **Reduced energy cost**

✓ **Longer travel distances**

✓ **Optimized charging infrastructure**

✓ **Shorter charging cycles**

✓ **Reduced service effort and LCC**

INTERN

03

Take-aways

Take-aways

- As the **pioneer in sustainable mobility**, Alstom is the only OEM (Original Equipment Manufacturer) offering **battery and hydrogen trains with references of both in commercial service**
- **Most complete and proven portfolio** on the market, for new build trains or modernisation
- Alstom developed **optimisation tools of energy storage and train operation**
- Based on building blocks developed to fit the different rolling stock needs, Alstom is **able to answer to all customer expectations**
- End-to-end technology responsibility through **strategic acquisitions** (Helion Hydrogen Power) and **partnerships**

Driver Advisory Systems are an integral part of Alstom's sustainable mobility programs

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