Sharing battery benchmark/experience/use cases to boost railway production (replacement to closed diesel lines)

SNCF Mobilités

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INTRODUCTION – A COMMON OBJECTIVE FOR TRAIN OPERATORS

Out of Diesel phase out in transportation services

2035
The French railway network, it’s around 30 000 km of tracks

- Non electrified
- Electrified (25 kV - 50 Hz / 1,5 kV DC)
- High speed (25 kV - 50 Hz)
BATTERY – A NEW FACTOR FOR TRAIN IMPROVEMENTS
ON-BOARD BATTERY USES CASES IN RAILWAY BUSINESS

**Suburban Train**
- Emergency Running (Back up mode)
- Power Assist / Recover braking energy

**Regional & Intercity Train**
- Power Assist / Recover braking energy
- Avoid Diesel & CO2 emission

**High Speed Train**
- Emergency Running (Back up mode)
- Peak load flexibility

**Freight Train**
- Last mile (dual mode)
- Avoid Diesel & CO2 emission
ON-BOARD BATTERY USES CASES IN RAILWAY BUSINESS

Suburban Train
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High Speed Train
- Emergency Running (Back up mode)
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Regional & Intercity Train
- Power Assist / Recover braking energy
- Avoid Diesel & CO2 emission
- Main scope of market for battery train

Freight Train
- Last mile (dual mode)
- Avoid Diesel & CO2 emission
KiHa E200 (2007) Hybrid Drive 15,2 kWh 3 trains

Kiya E991 (2003) Hybrid drive 10 – 15,2 kWh 1 train

ACCUM EV-E301 (2014) BEMU (1,5kV DC) 190 kWh 4 trains

DENCHA S819 (2013) BEMU (20kV AC) 380 kWh 7 trains
BATTERY TRAIN FOR REGIONAL APP IS TRENDY IN EUROPE (HYBRID, BEMU, H2)

Abellio Greater Anglia / BOMBARDIER CLASS 379
VIVARAIL / MV CLASS 230
BREEZE / BREL CLASS 321
HYDROFLEX / BREL CLASS 319
Wales & Borders / STADLER FLIRT (24 trains)
Bade-Wurtemberg / BOMBARDIER TALENT 3
SNCF / ALSTOM CORADIA Hybrid
SNCF / ALSTOM CORADIA H2

Friesland Groningen / STALDER WINK NAH!SH / STADLER FLIRT (55 trains)
FNM / STADLER FLIRT hybrid (30 trains)
LNVG / ALSTOM iLint H2 (14 trains)
LNVG / ALSTOM iLint H2 (27 trains)
Bade-Wurtemberg / SIEMENS MIREO (20 trains)
GBB / SIEMENS DESIRO
Zillertalbahn / STADLER H2 narrow gauge (5 trains)
SNCF Mobilités - AP CHAMARET
UIC Workshop “The End of Fossil Fuels”
BATTERY TECHNOLOGIES IN ROLLING STOCK:

Size of battery capacity on-board for BEMU application:

- 300 kWh (Optional: 440 kWh)
  - 40 km (Max: 100 km)

- 528 kWh
  - 80 km (Max: 100 km)

- 180 kWh
  - 80 km (Max: 150 km)

- 190 kWh
  - 40 km

- 360 kWh
  - 20 km (Max: 80 km)

- 500 kWh
  - 50 km
BATTERY TECHNOLOGIES IN ROLLING STOCK: TECHNOLOGIES USED

TALENT 3 (GER)
iLint H2 (GER)
TER Hybride (FR)
FLIRT (WLS)

ACCUM (JP)
ELECTROSTAR (UK)
DESIRO ECO (AUT)

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LTO technology takes the lead today in the design of battery train:

**Advantages:**
- > 10 000 cycles
- Lower risk of fire

**Disadvantages:**
- ≈1000 $/kWh
- ≈80 Wh/kg

**Some suppliers of LTO:**
- Toshiba
- Leclanché
- Microvast
Focus on SNCF “TER Hybride” use case
SNCF’S USE CASE: TER HYBRIDE—WHAT IT MEANS?

Technical solution to apply:

1. Two Powerpacks (300Kw) removed
2. Replaced by 2 energy storage system

REGIOLIS PPM Bimode train
SNCF’S USE CASE: TER HYBRIDE - STAKEHOLDERS

ALSTOM

Occitanie

Grand-Est

Nouvelle - Aquitaine

Centre-Val de Loire
SNCF’S USE CASE: TER HYBRIDE - PLANNING

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SNCF’S USE CASE: TER HYBRIDE - PLANNING

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SNCF’S USE CASE: TER HYBRIDE - BENEFITS OF BATTERIES TECHNOLOGY

Goals

- 20% energy saved
- 30% to 50% maintenance costs reduced.
- 20% Greenhouse gas emission reduced

New functions

- BATTERY MODE
- BOOST MODE
- STOP & START DIESEL ENGINES
SNCF’S USE CASE: TER HYBRIDE - NEW ISSUES TO DEAL WITH

- Impacts of the downgraded modes
- Impacts of the battery’s life on train performances
- New precautions for train maintenance
- Train on rescue mode
- New approach on time table calculation
- Driver’s training

Different relevant zones on the rail network

- Relevant
- Not relevant

Different relevant zones on the rail network:
- High stop frequency
- Low stop frequency
- Flat
- Mountain
SNCF’S USE CASE: TER HYBRIDE - ROAD MAP

**Hybrid train**
- Functions testing
- Gains checking

**Deployment of hybridisation**
- On existing diesel trains

- Lower carbon emissions
- Lower energy consumption

- No needs to change the infrastructure
- Half diesel motors removed

**Alternative fuel Hybrid train**
- Hydrogen

**Battery Train**
- End of diesel traction by 2035

**Very low carbon emissions**
THANK YOU FOR YOUR ATTENTION