



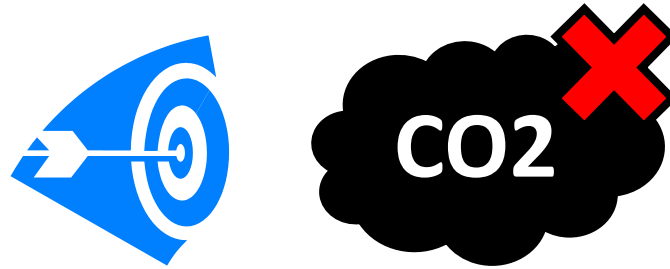
Sharing battery benchmark/experience/use cases to boost railway production (replacement to closed diesel lines)

SNCF Mobilités

André-philippe CHAMARET



INTRODUCTION – A COMMON OBJECTIVE FOR TRAIN OPERATORS

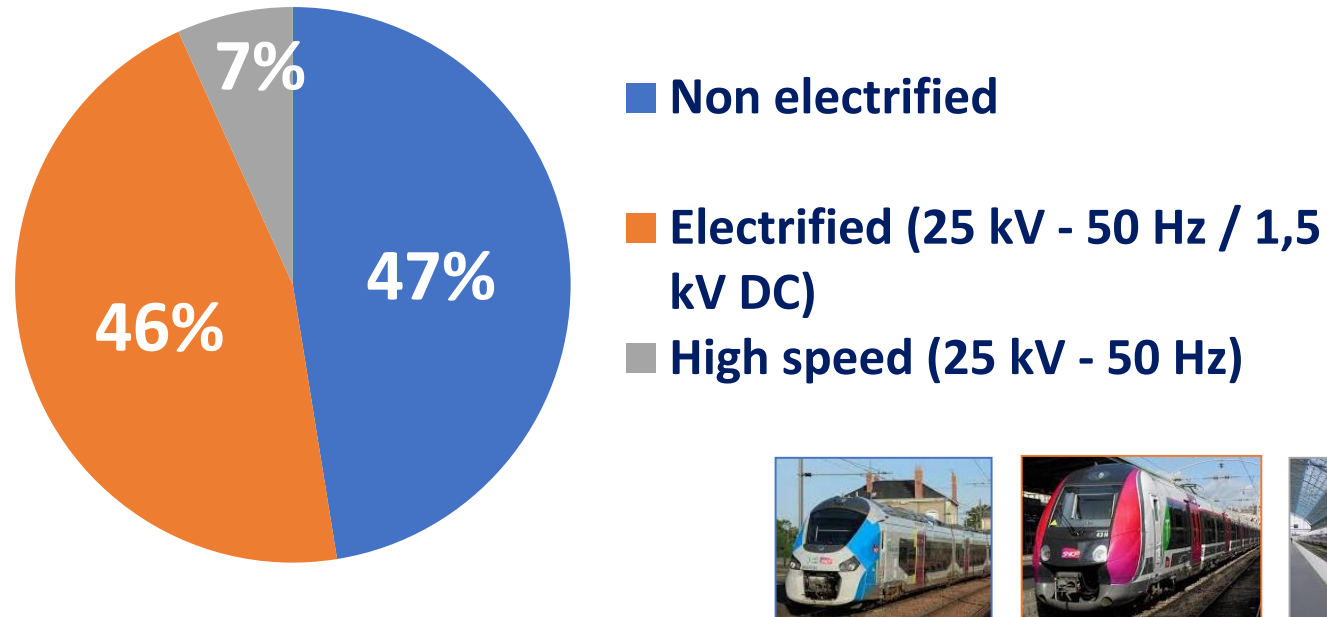


Out of Diesel phase out in transportation services

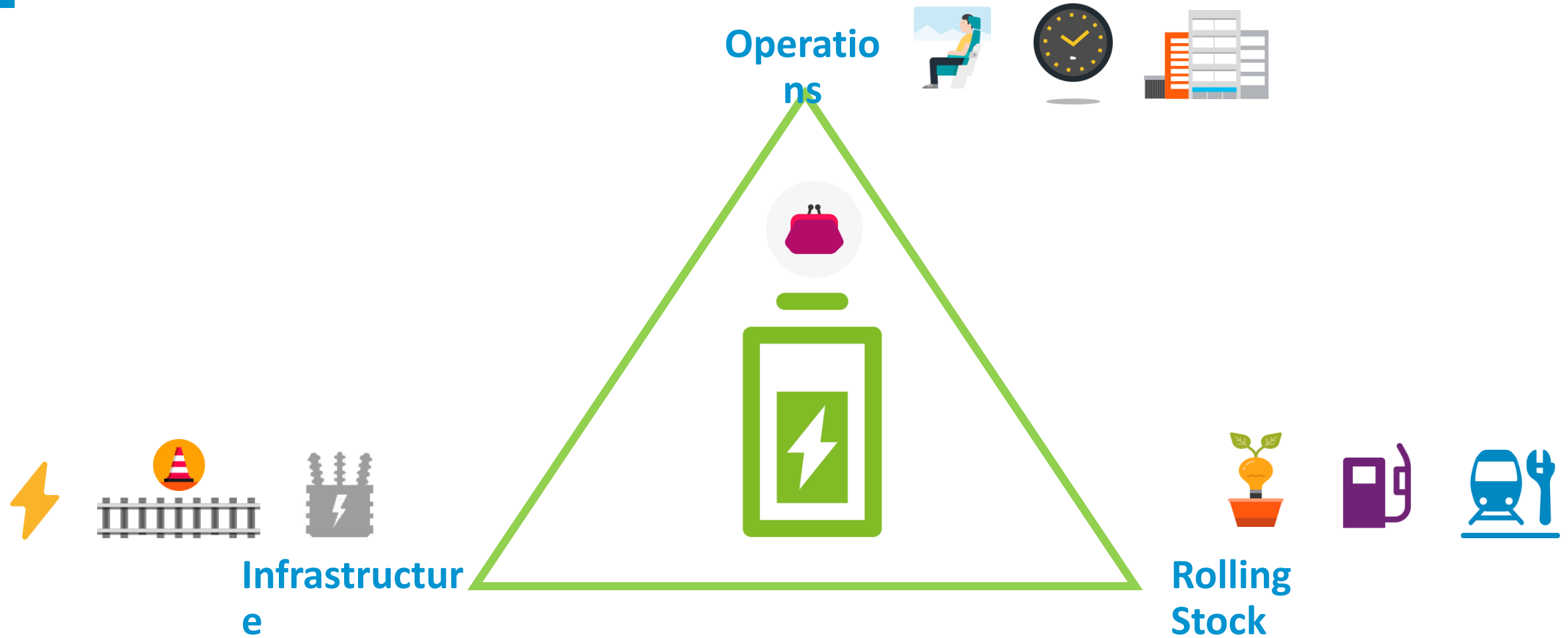


INTRODUCTION – FRANCE CONTEXT

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



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

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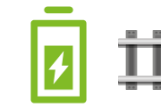
Power Assist / Recover braking energy



Avoid Diesel & CO2 emission

Main scope of market for battery train

Freight Train



Last mile (dual mode)



Avoid Diesel & CO2 emission

JAPAN, A REFERENCE FOR BATTERY TRAINS EXPERIENCE



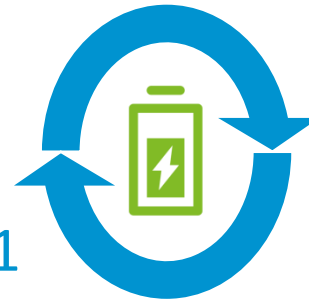
Kiya E991
(2003)
Hybrid drive
10 – 15,2 kWh
1 train



KiHa E200
(2007)
Hybrid Drive
15,2 kWh
3 trains

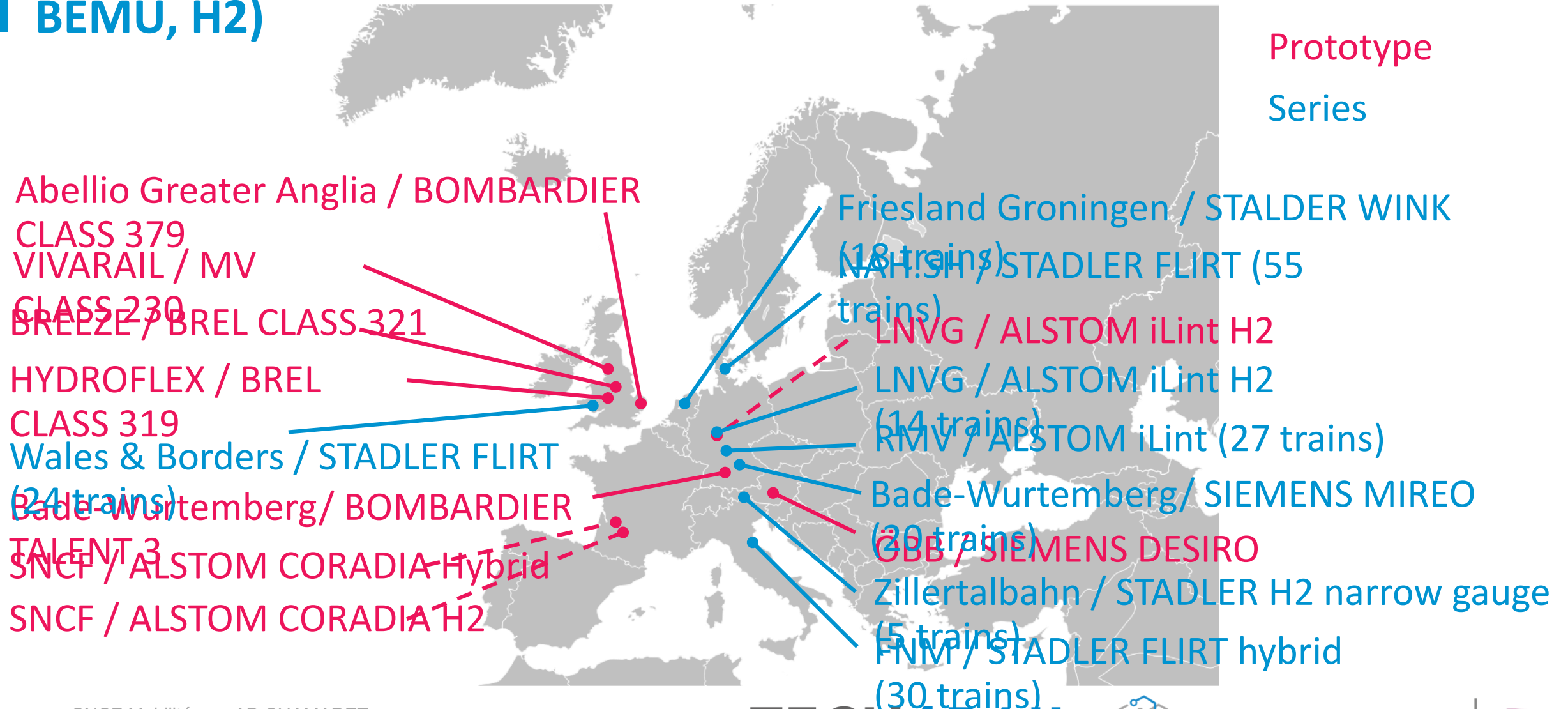


ACCUM EV-E301
(2014)
BEMU (1,5kV DC)
190 kWh
4 trains



DENCHA S819
(2013)
BEMU (20kV AC)
380 kWh
7 trains

BATTERY TRAIN FOR REGIONAL APP IS TRENDY IN EUROPE (HYBRID, BEMU, H2)



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)

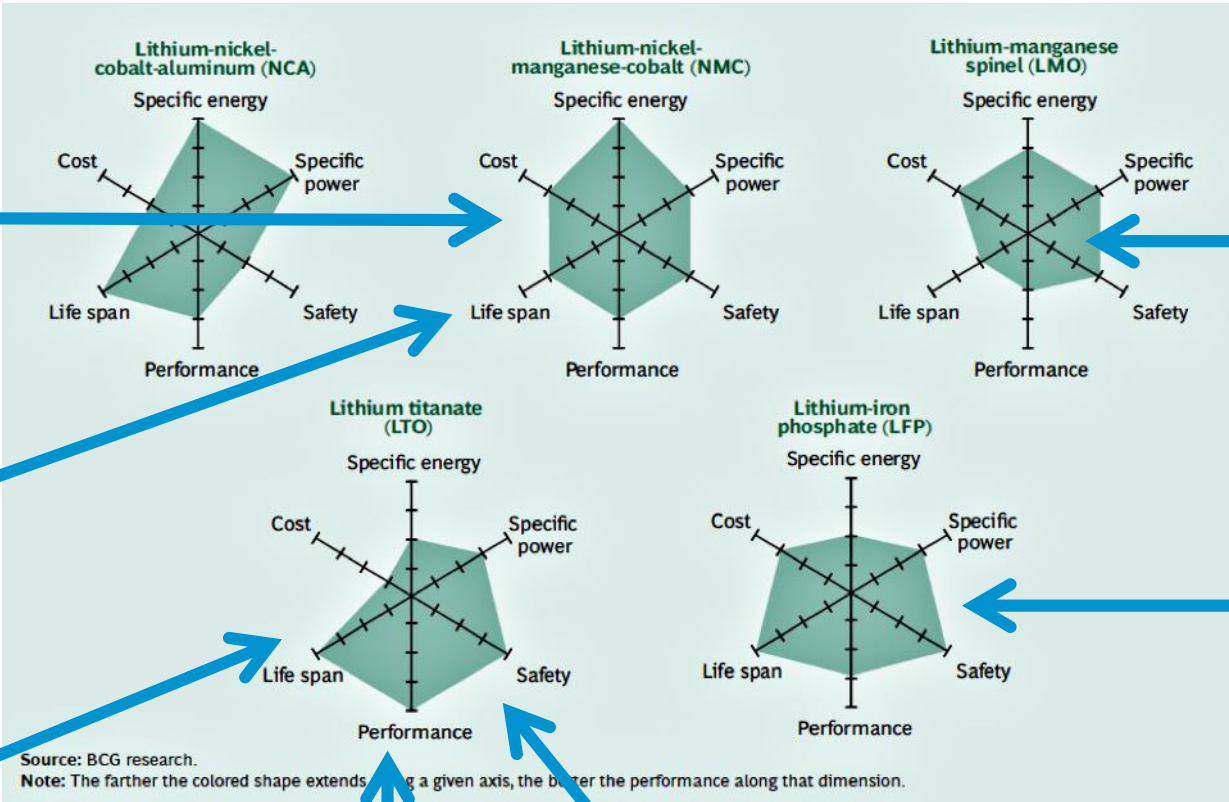


DESIRO ECO (AUT)

ACCUM (JP)



ELECTROSTAR



BATTERY TECHNOLOGIES IN ROLLING STOCK: TECHNOLOGIES USED

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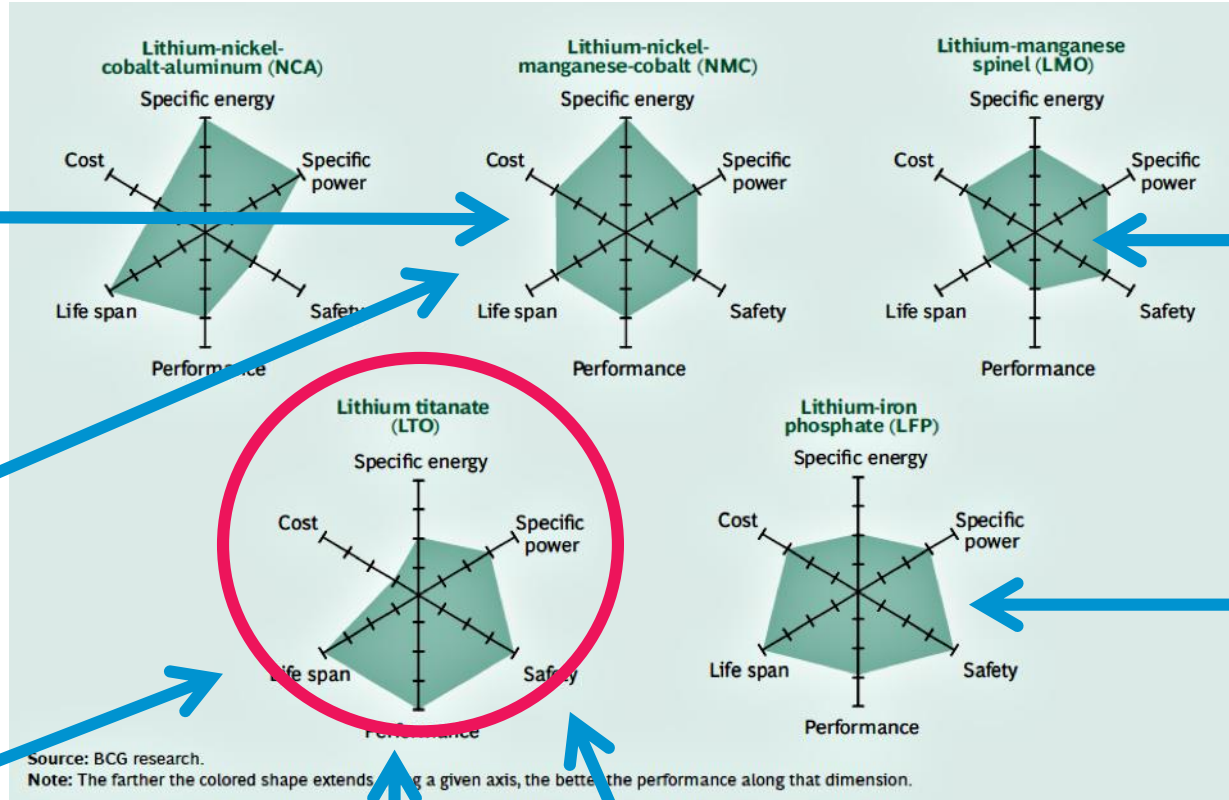


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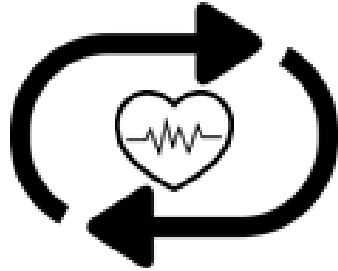
ELECTROSTAR



BATTERY TECHNOLOGIES IN ROLLING STOCK: Some suppliers of LTO:

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



TOSHIBA
Leading Innovation >>>



Leclanché
Energy Storage Solutions



microvast

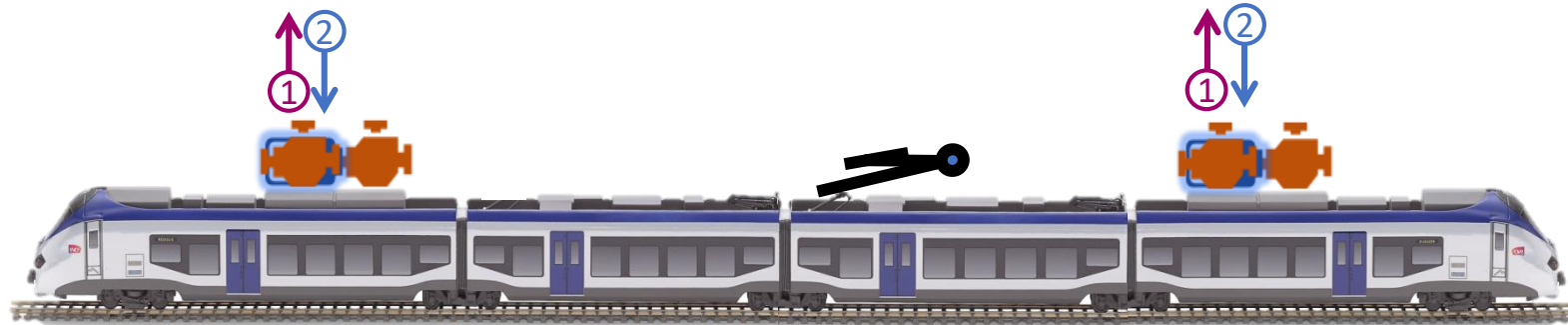
Focus on SNCF “TER Hybride” use case



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



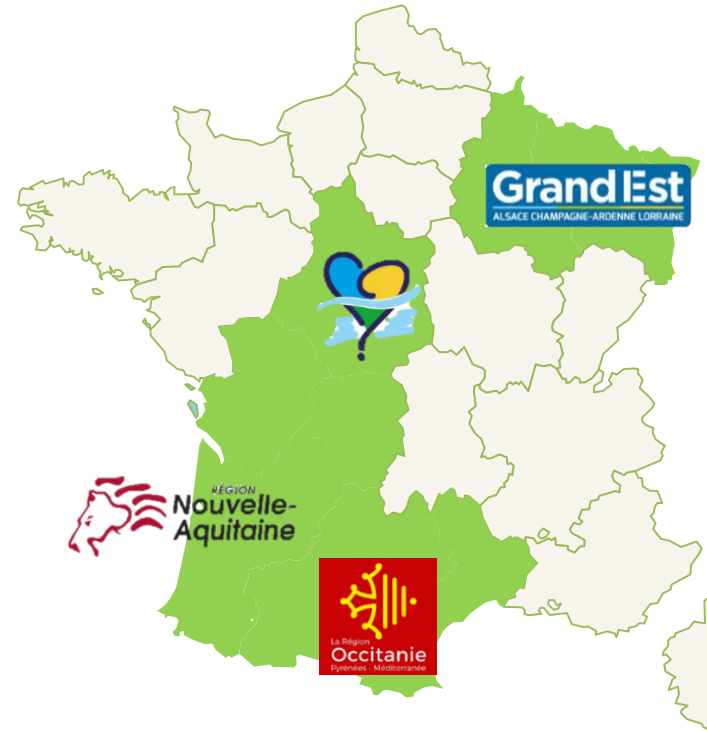
Grand-Est



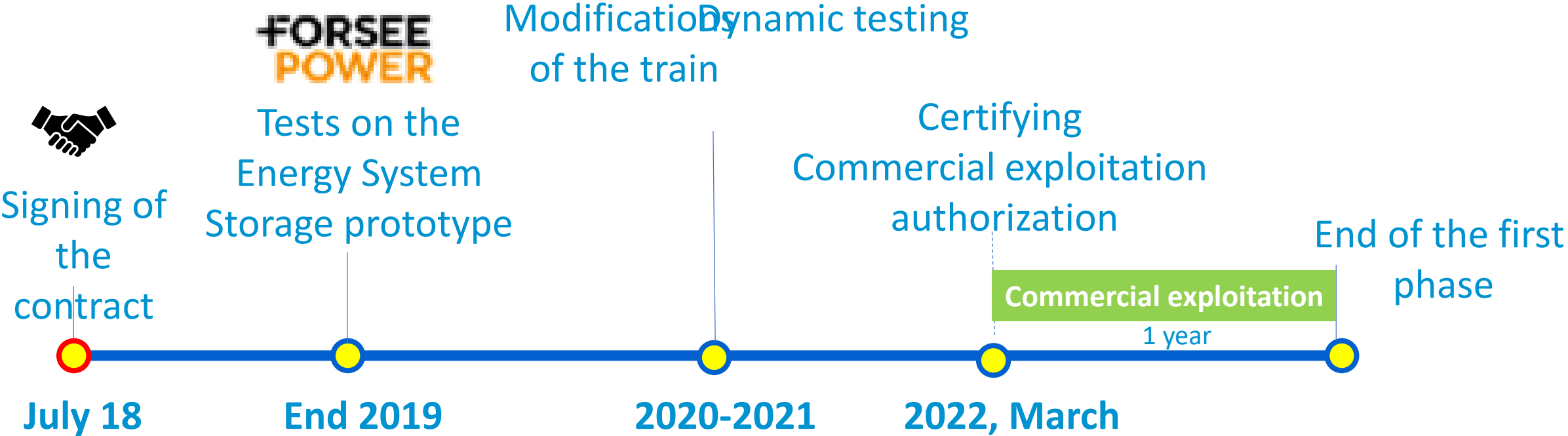
Nouvelle - Aquitaine



Centre-Val de Loire



SNCF'S USE CASE: TER HYBRIDE - PLANNING



SNCF'S USE CASE: TER HYBRIDE - BENEFITS OF BATTERIES

TECHNOLOGY

Goals



20% energy saved

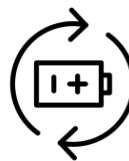


30% to 50% maintenance costs reduced.



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



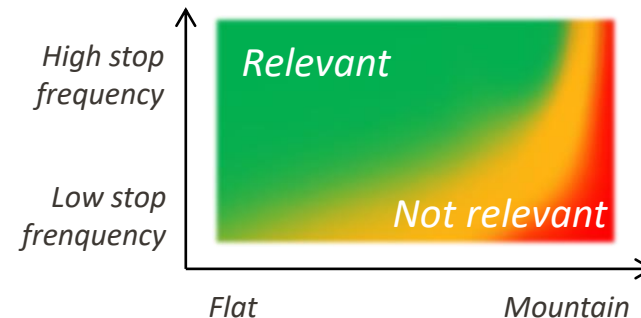
Train on rescue mode



New approach on time table calculation

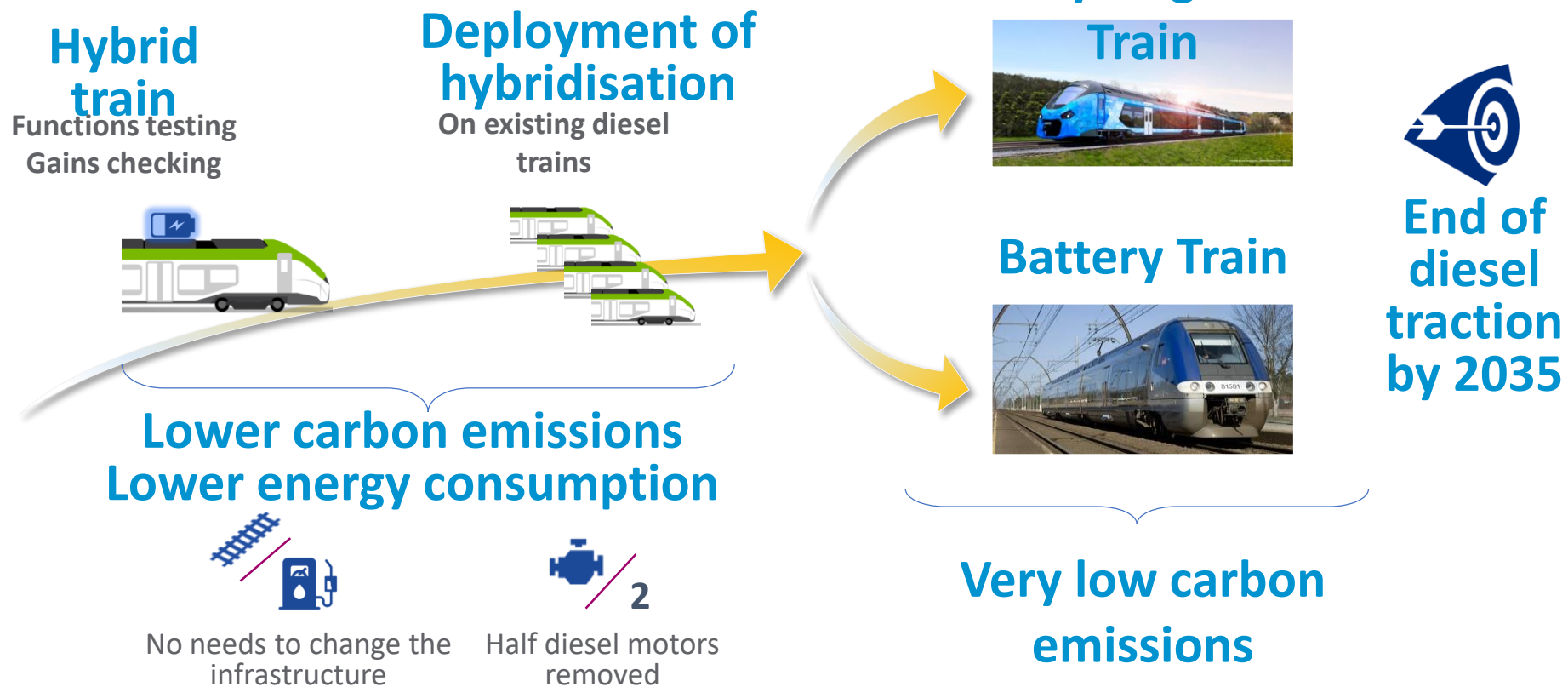


Driver's training



Different relevant zones on the rail network

SNCF'S USE CASE: TER HYBRIDE - ROAD MAP



THANK YOU FOR YOUR ATTENTION

