

HYDROGEN TRAIN PROJECT

Arising post-carbon solutions



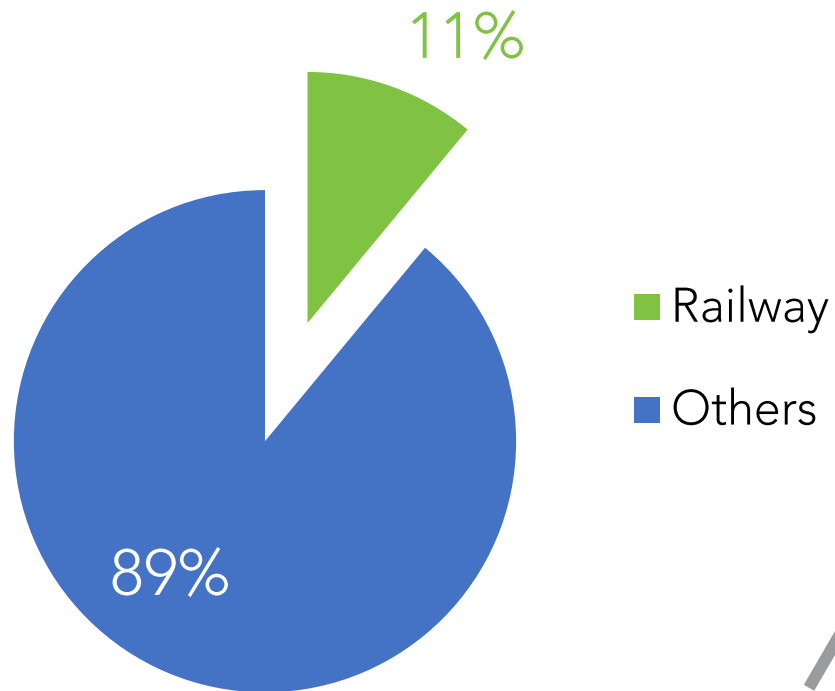
DECARBONISATION CHALLENGES FOR FRENCH RAILWAY TRANSPORTATION

FRENCH RAILWAY PERFORMANCES

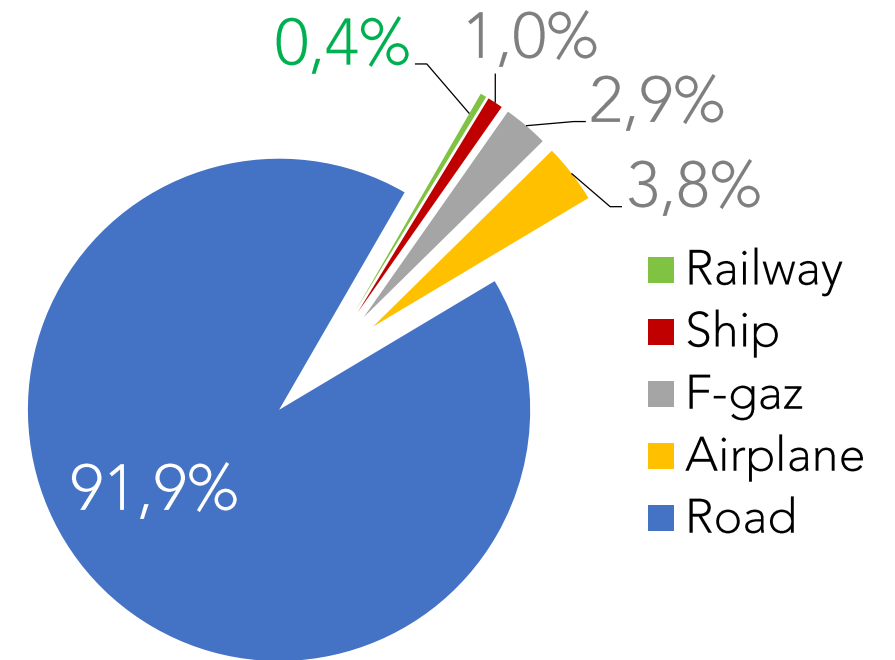


A CO2 EFFICIENT TRANSPORTATION SOLUTION

passanger.km or tonne.km



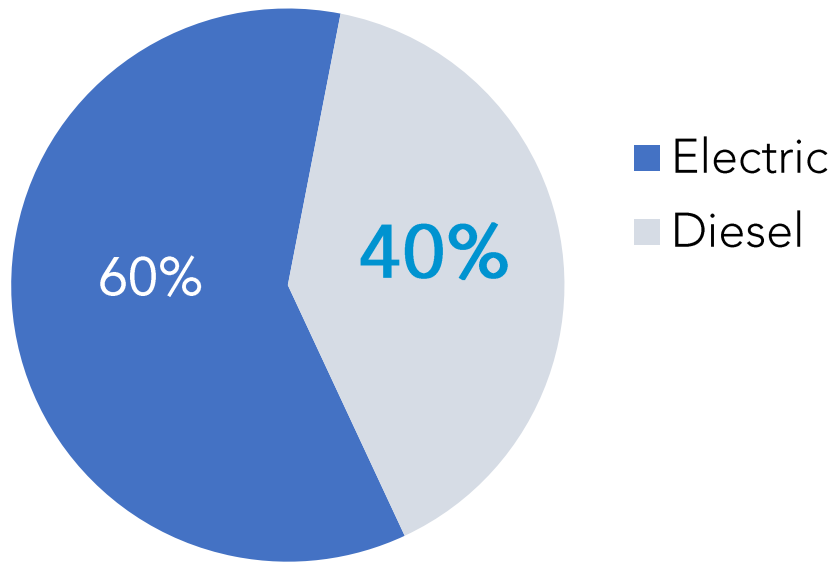
CO₂e emissions



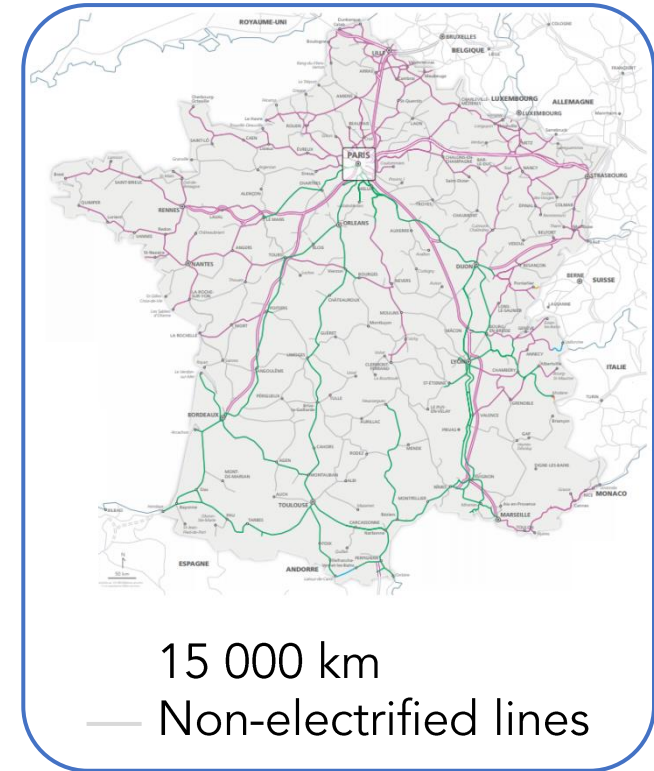
FOSSIL FUEL TRACTION

REGIONAL TRAFFIC USING DIESEL WITH TERRITORIAL DEVELOPMENT STAKES

Regional traffic - train.km



50%



SNCF ANNOUNCEMENT : END OF FOSSIL FUELS TRAINS BY 2035



Raison d'être
the **freedom** of **effortless**
mobility and a **greener planet**

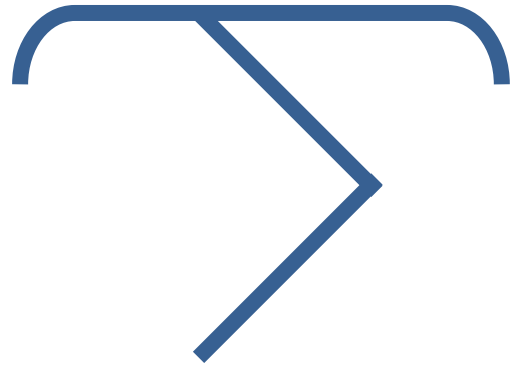
BIMODES TRAIN IN FRANCE



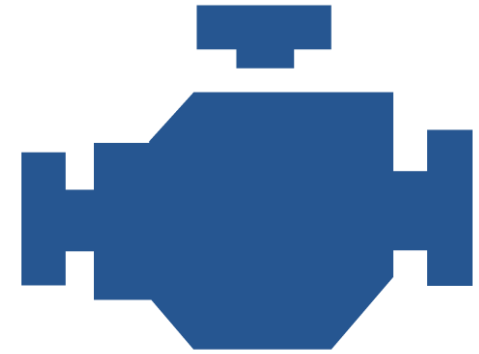
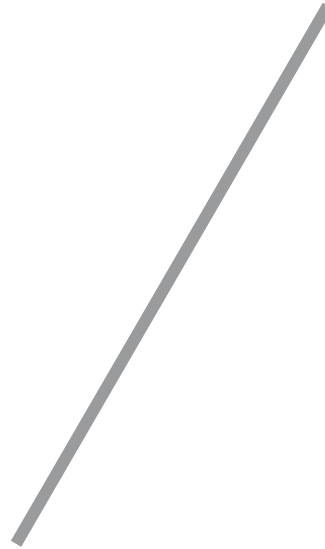
450 BIMODES MULTIPLE UNITS SINCE 2004 : 20% OF REGIONAL TRAFFIC

AGC by BOMBARDIER & Régiolis by ALSTOM

✓ NO DIESEL OPERATING UNDER CATENARIES



Electric mode



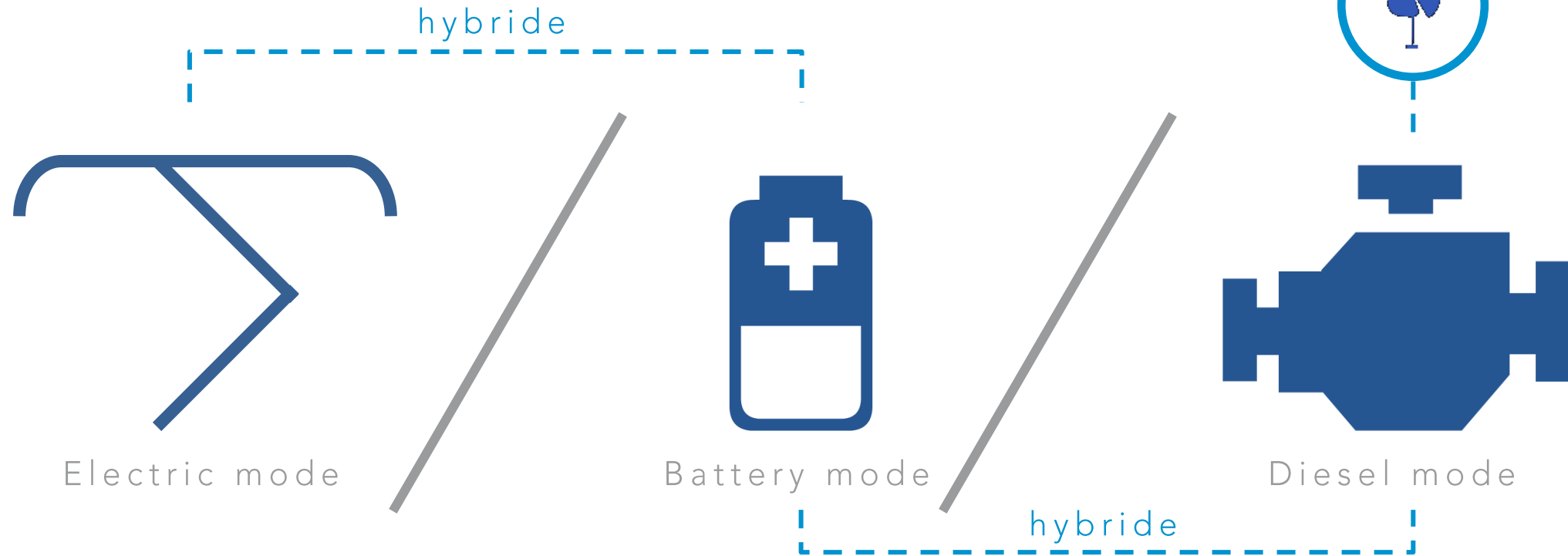
Diesel mode

HYBRID TRAIN IN FRANCE

1st THREE MODES REGIONAL HYBRID TRAIN
TESTS ON COMMERCIAL SERVICE : 2021
FLEET DEPLOYMENT : 2022

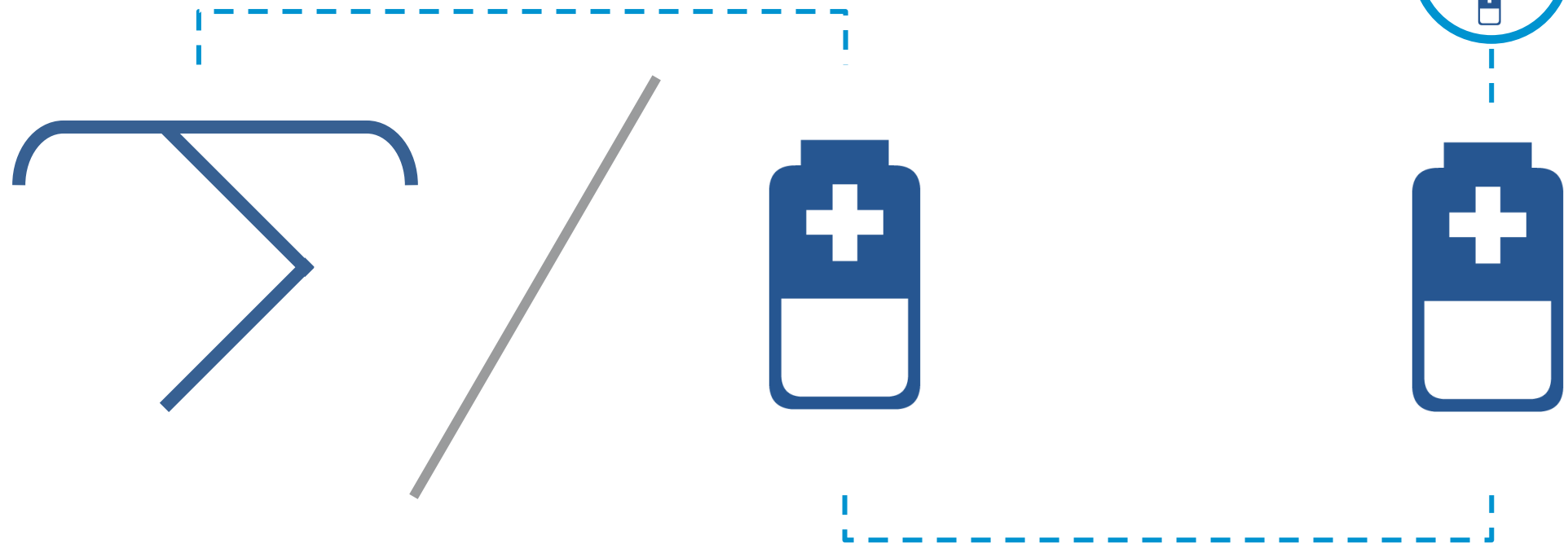


Biofuel B100
> -60% CO₂
Quick win



BATTERY TRAIN PROJECT

FEW TECHNICAL CHALLENGES : batteries and charging points
IMPORTANT OPERATIONAL CHALLENGES
AND SYSTEM TRAIN + INFRA OPTIMISATION : limited autonomy

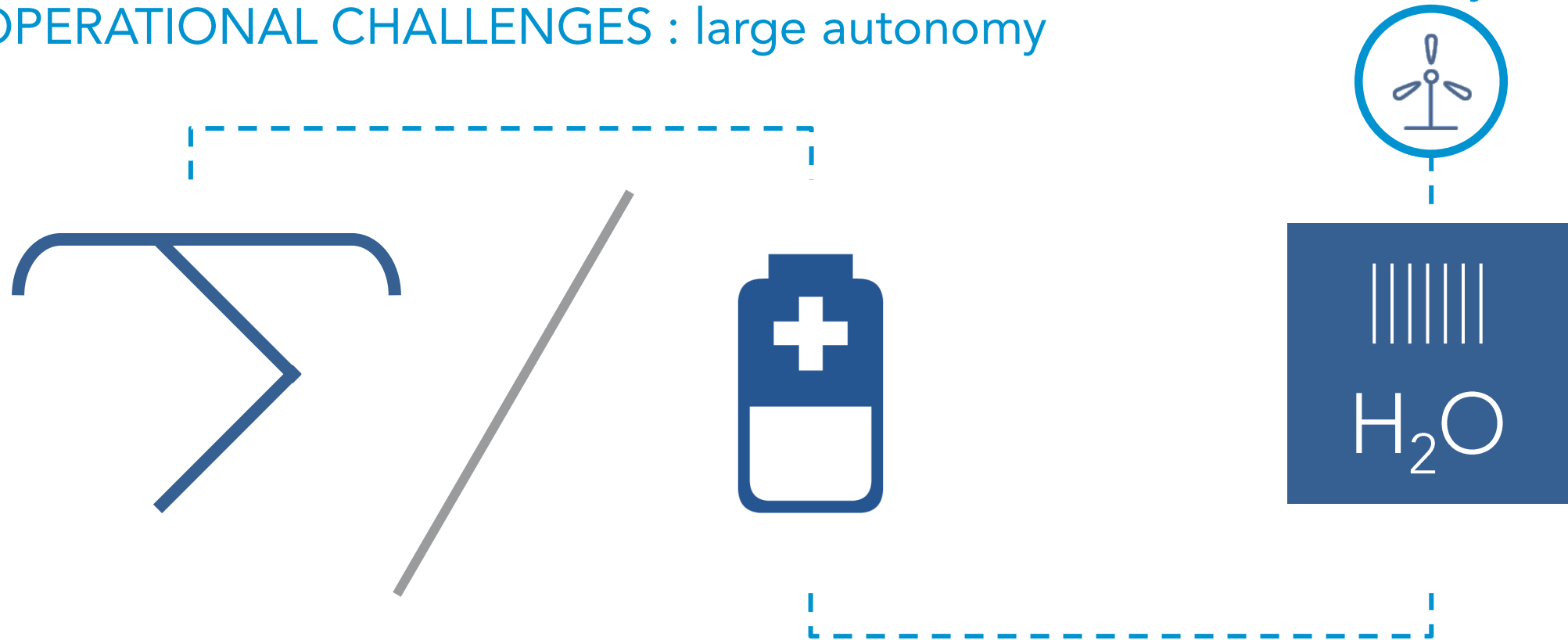


HYDROGEN TRAIN PROJECT

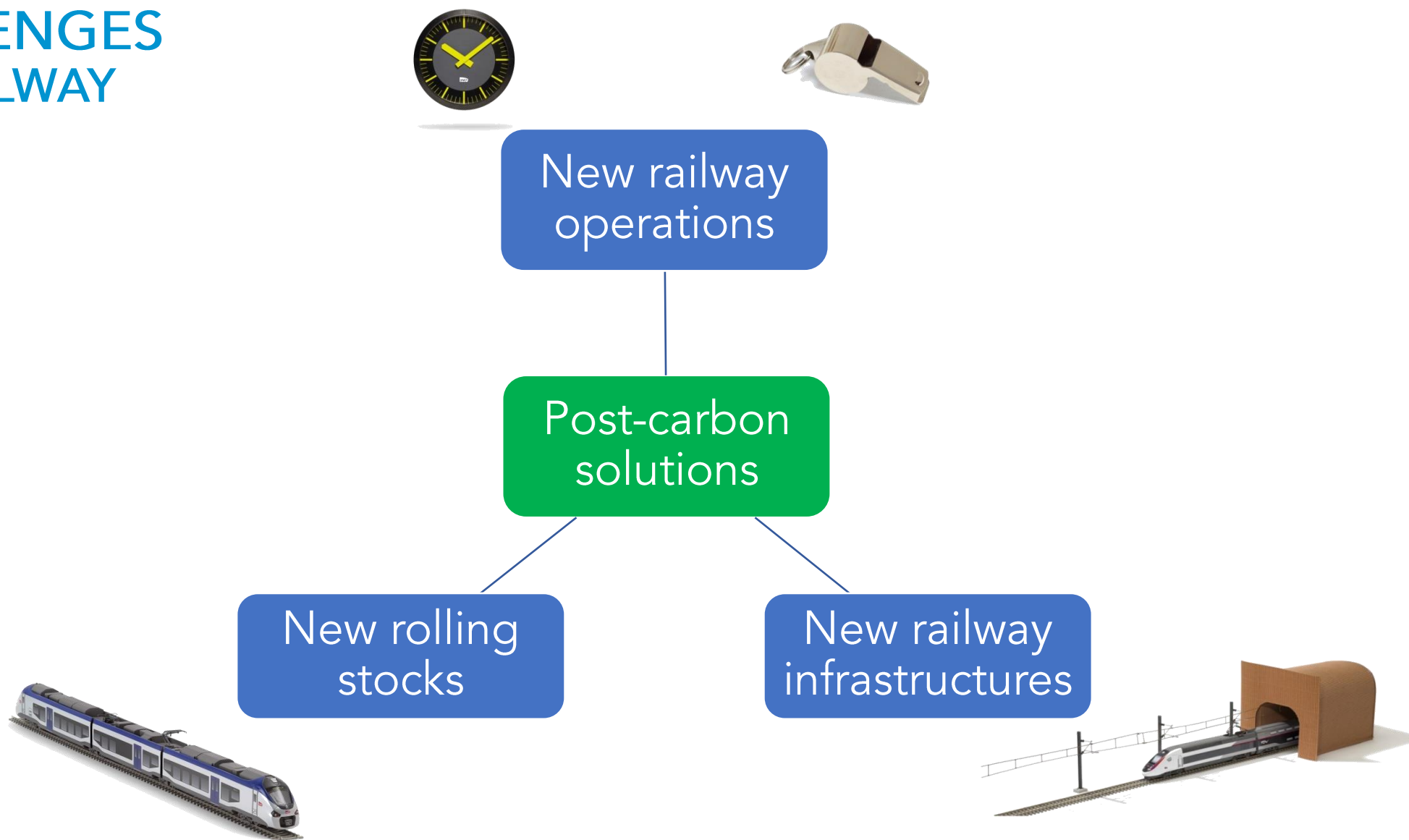


1st BI-MODES REGIONAL H2 TRAIN

IMPORTANT TECHNICAL AND SYSTEM CHALLENGES : Green H2 ecosystem
FEW OPERATIONAL CHALLENGES : large autonomy



CHALLENGES FOR RAILWAY



CHALLENGES FOR REGIONS

Mobility as a service



New
operations

Post-carbon
solutions

New vehicles

New
infrastructures

Smart grids

H2 stations

Local production of energy



HYDROGEN TRAIN PROJECT



ENGAGEMENT TOWARD H2 TRAIN

2018

- France goal : 1st train by 2022
- SNCF ambition to end diesel operations by 2035

2022 – 2028

- **Demonstration** : SNCF support the regions with a first mini fleet
- **Feedback** on daily operational conditions and on economical and environmental performances
- **New regulations**

2035

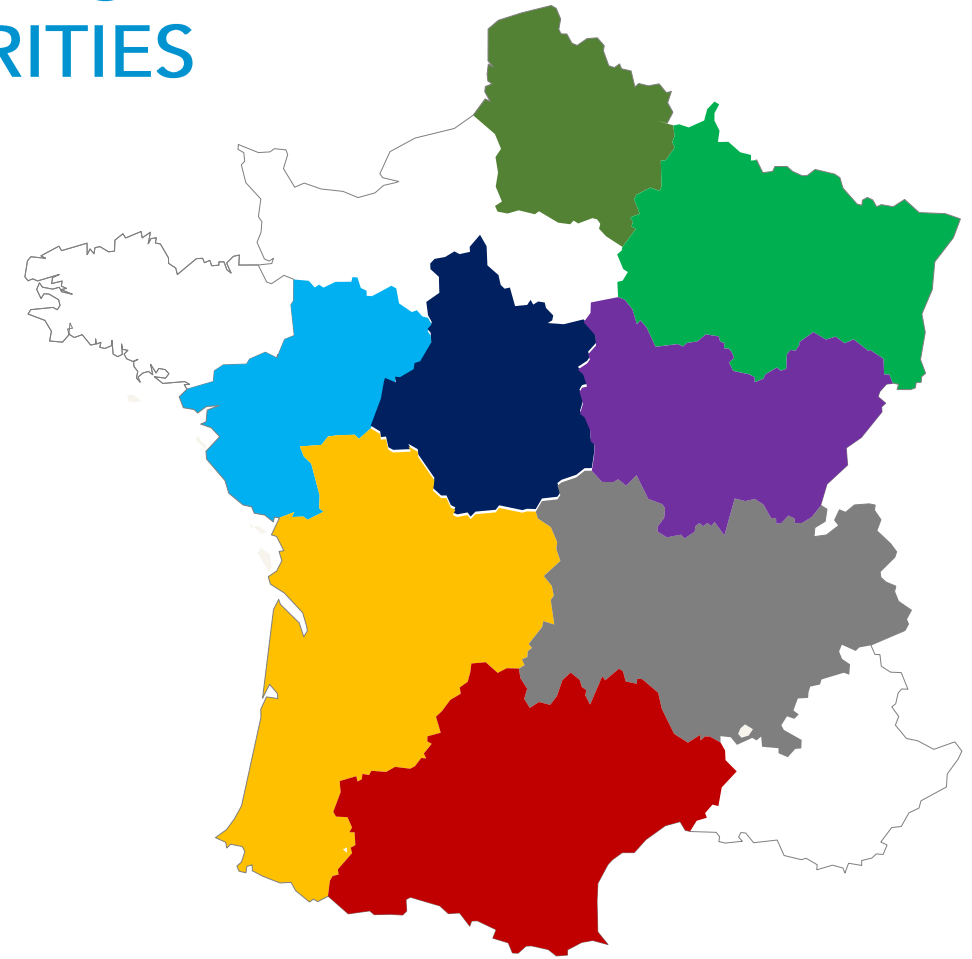
- Potential **deployment** for relevant operations for H2 train

SNCF TO QUALIFY H2 OPPORTUNITIES FOR REGIONAL TRANSPORTATION AUTHORITIES

H2 train specification

Selection of relevant railway operations to deploy a mini fleet

Evaluation of local conditions for H2 train deployment : refueling, maintenance,...



8 interested regions

H2 TRAIN CHOICE



A large capacity and bimode train : to increase the market size and maintain the operations flexibility

Ability to operate a 4 coaches regional train with 230 seats on the whole railway network with the most efficient energy

An existing train : to allow retrofit of a recent bimode fleet

The demonstrator project proposes the development of an H2 train on an existing platform

PERFORMANCES

- Maximum speed : 160 km/h
- Autonomy : 400 to 500 km
- Power : 700 to 900 kW
- H2 : 200 kg at 350 bars



REMAINING CHALLENGES

A limited range with available volumes

Regulation & safety issues of catenary with H2 in confined spaces

New partnership model for the refueling infrastructures considering possible synergies with other usages



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THANK YOU FOR YOU ATTENTION