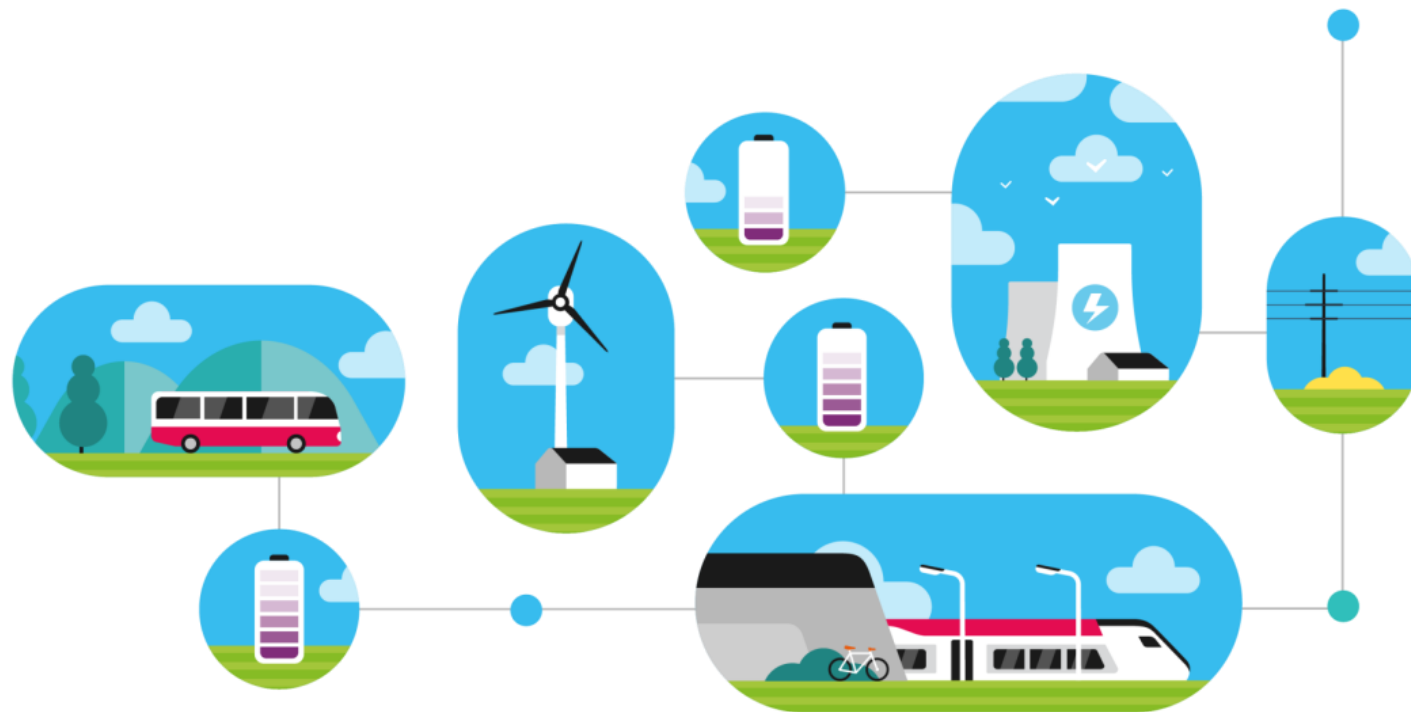


Hydrogen Train Project

May, 17th 2019



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France rail network electrification

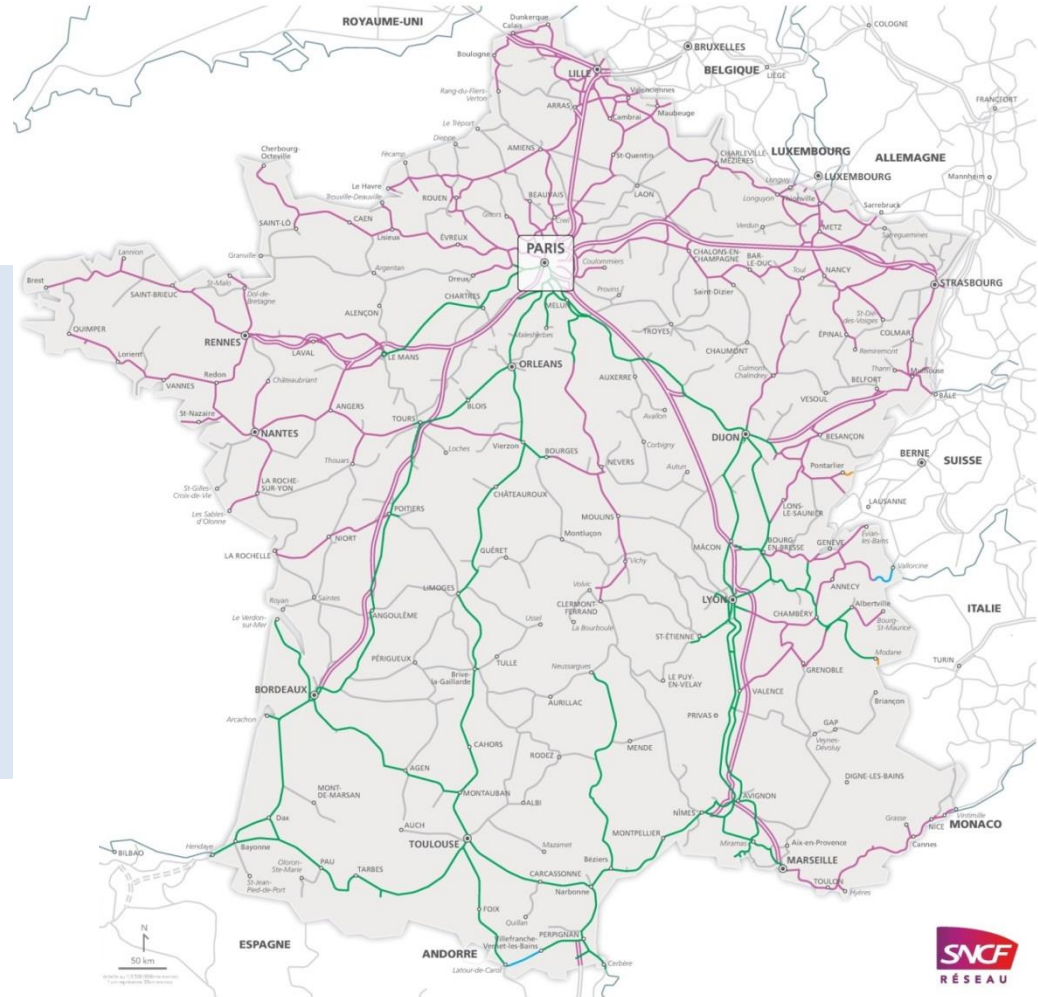


15 500 km

of electrified lines
(50% of network)

80 %

of SNCF rail operation is done
by electric trains



SNCF Réseau 2017

Improvement potential rolling stock



0,4 % CO₂

of carbon emissions in transport is done through rail
(for shares :11,2% of passenger.km and 10,5% of tons.km)*

20%

**Of national traffic is
operated by diesel**

↗ **600,000 tons of CO₂ emission per year (2017)**

Regional train fleet

2300 trains

- ↗ **50 % of TER train fleet is equipped with diesel engines**, representing 40% of kilometres operated, mono mode and bi-mode
- ↗ Long rolling stock lifetime over **40 years : investment for rail decarbonisation is needed today in order to remain competitive against road transport and be ready large fleet renewal**

SNCF objectives toward decarbonisation



2015 – 2025



Improve energy efficiency by 25%



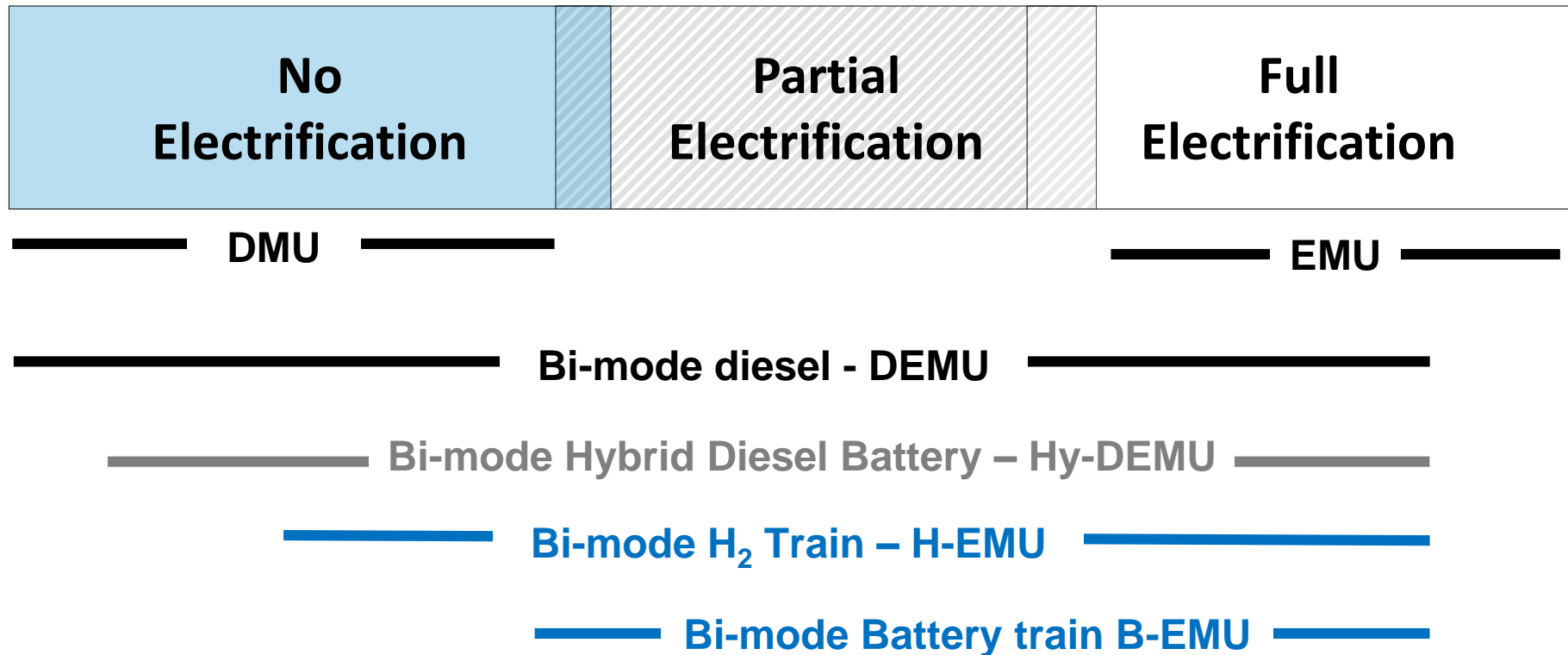
Improve carbon performance by 20%

2035

End of diesel train operations



Hydrogen part of the solution portfolio



Our portfolio is built to value the complementarity of solutions



Operational



Technical



Politic



Societal



Business Model



Operation flexibility & market size

- Bi-mode train → ability to operate on the whole rail network
- More capacity → suitable for medium traffic

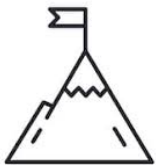


Integration on an existing train platform

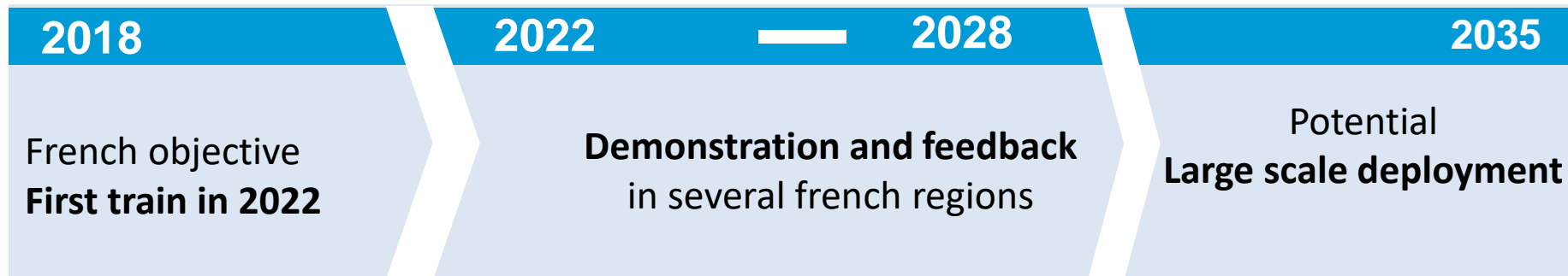
The demonstrator project involves the development of a new FCH train on an existing platform with the ability of retrofit in mind

Remaining challenges

- Available volumes → Limited H₂ autonomy
- Regulation/safety of catenary and H₂ in confined spaces
- New partnership model for refueling infrastructure, considering synergies without other usage
- Securing the financial roundtable to kick-off FCH train demo



Hydrogen deployment roadmap



➤ French transport minister to develop a FCH train by 2022

➤ Specification of the train and conception of infrastructures

➤ SNCF support the French regions in deploying a first mini fleet

➤ Generate feedback on operational conditions and economic performance

➤ Sustainability and replicable business model

➤ Adapted regulation