iLint: Hydrogen Fuel Cell Train (HFC)

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23/10/2019

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Designing fluidity

The proportion of non-electrified railway lines is comparatively high in Germany

Electrification in the German rail network

- Over 40% (17,740km) of the German rail network is not electrified
- Planned increase in electrification level to 70 % by 2025 mainly
- Approx. 36% (240 Mio. Train/ KM) of the regional lines are operated by diesel vehicles
- High complexity of electrification requires long planning horizons and high construction costs
- Construction costs per km: more than 1 million €/km
- Total construction time: approx. 5 - 7 years

Need for alternative propulsion technology

Considerable part of the **railway network not electrified**

Emission-free trains for not-electrified routes

Medium and long-term **rising prices for diesel**

Alternative to fossil fuel

Legislation and forecasts regarding **climate protection and noise reduction**

Climate protection and noise reduction

Falling acceptance and political discussions about **diesel driving ban in urban areas**

Compliant technology

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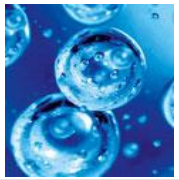
iLint: The Technology – transformation from Diesel to HMU

Removal of diesel propulsion system



Integration of electrical propulsion system

Diesel powerpack

Diesel tank

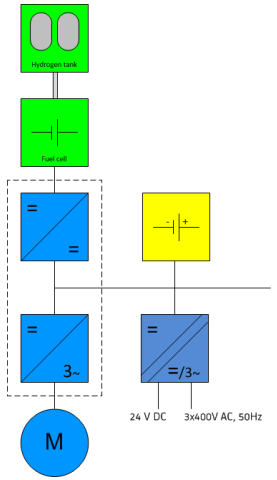
Hydrogen tank

Fuel cell pack

Battery pack

Converter system

Electrical traction motor



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iLint: Design criteria

- Use of proven reliable product as base
- No significant changes in weight/point of gravity
- Re-use of train architecture and main components
- Maintain performance (availability, reliability, acceleration, range, etc)
- Avoid technical equipment in passenger areas
- No adverse impact on passenger experience and comfort
- High energy efficiency
- Interoperability (mixed fleet)
- Possibility to retrofit existing trains
- Scalability of components to make technology suitable for other platforms

RS + Maintenance and Hydrogen supply … a complete mobility solution

Erection and Operation of **H_2-infrastructure** (with partner)

Performing **Maintenance** und **Repair**

Delivery of **trains**

Alstom provides emission-free availability

Operator receives maintained and refilled train!

Passengers receive emission-free mobility with increased comfort!

Hydrogen contributing to de-carbonisation

minus
700t CO_2
per year…

…equals annual emissions of
400 cars

Reduction per iLint vehicle

minus
11.000t CO_2
per year…

…equals annual emissions of
6.000 cars

Reduction per iLint fleet

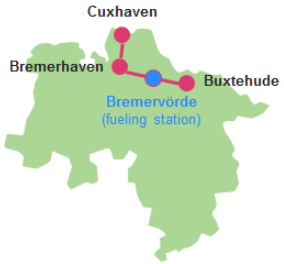
CORADIA iLint - entering into daily passenger revenue service on Sept. 16, 2018

The New York Times

Trains powered by hydrogen fuel cells are being pitched in Germany as an alternative to stringing wires on rail lines that are not electrified. David Hecker/EPA, via Shutterstock

Hydrogen-powered trains begin service in Germany.

In a breakthrough for a green fuel, two hydrogen-powered trains are expected to go into commercial service Monday on a rail line in northern Germany near Hamburg. The trains, which will serve cities including Bremerhaven and Cuxhaven, will be powered by hydrogen fuel cells that generate electricity through a chemical reaction. The trains are being promoted as a cheaper alternative to stringing wires on rail lines that are not electrified. Hydrogen-powered vehicles produce no emissions of carbon dioxide, which is blamed for climate change, or other pollutants……



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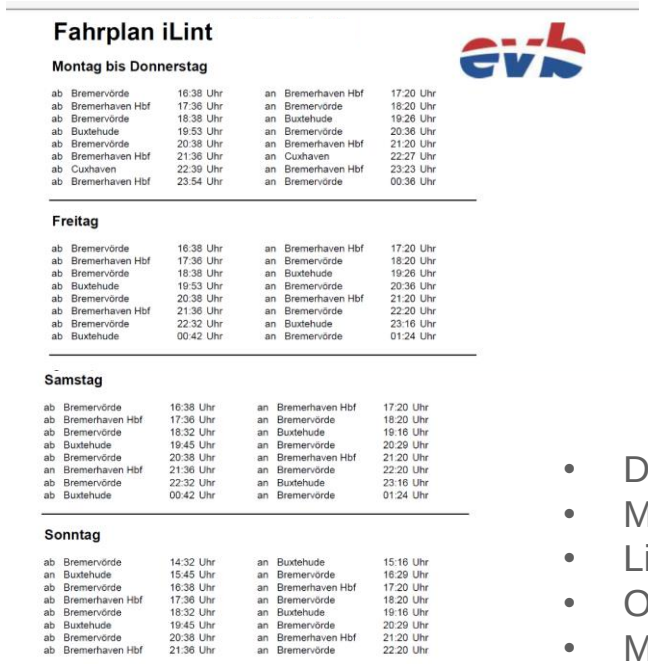
Daily revenue service operation in the north of Germany



Fahrplan iLint

evb

Montag bis Donnerstag

ab	Bremervörde	16:38 Uhr	an	Bremerhaven Hbf	17:20 Uhr
ab	Bremerhaven Hbf	17:36 Uhr	an	Bremervörde	18:20 Uhr
ab	Bremervörde	18:38 Uhr	an	Buxtehude	19:26 Uhr
ab	Buxtehude	19:53 Uhr	an	Bremervörde	20:36 Uhr
ab	Bremervörde	20:38 Uhr	an	Bremerhaven Hbf	21:20 Uhr
ab	Bremerhaven Hbf	21:36 Uhr	an	Cuxhaven	22:27 Uhr
ab	Cuxhaven	22:39 Uhr	an	Bremerhaven Hbf	23:23 Uhr
ab	Bremerhaven Hbf	23:54 Uhr	an	Bremervörde	00:36 Uhr

Freitag

ab	Bremervörde	16:38 Uhr	an	Bremerhaven Hbf	17:20 Uhr
ab	Bremerhaven Hbf	17:36 Uhr	an	Bremervörde	18:20 Uhr
ab	Bremervörde	18:38 Uhr	an	Buxtehude	19:26 Uhr
ab	Buxtehude	19:53 Uhr	an	Bremervörde	20:36 Uhr
ab	Bremervörde	20:38 Uhr	an	Bremerhaven Hbf	21:20 Uhr
ab	Bremerhaven Hbf	21:36 Uhr	an	Bremervörde	22:20 Uhr
ab	Bremervörde	22:32 Uhr	an	Buxtehude	23:16 Uhr
ab	Buxtehude	00:42 Uhr	an	Bremervörde	01:24 Uhr

Samstag

ab	Bremervörde	16:38 Uhr	an	Bremerhaven Hbf	17:20 Uhr
ab	Bremerhaven Hbf	17:36 Uhr	an	Bremervörde	18:20 Uhr
ab	Bremervörde	18:32 Uhr	an	Buxtehude	19:16 Uhr
ab	Buxtehude	19:45 Uhr	an	Bremervörde	20:29 Uhr
ab	Bremervörde	20:38 Uhr	an	Bremerhaven Hbf	21:20 Uhr
an	Bremerhaven Hbf	21:36 Uhr	an	Bremervörde	22:20 Uhr
ab	Bremervörde	22:32 Uhr	an	Buxtehude	23:16 Uhr
ab	Buxtehude	00:42 Uhr	an	Bremervörde	01:24 Uhr

Sonntag

ab	Bremervörde	14:32 Uhr	an	Buxtehude	15:16 Uhr
an	Buxtehude	15:45 Uhr	an	Bremervörde	16:29 Uhr
ab	Bremervörde	16:38 Uhr	an	Bremerhaven Hbf	17:20 Uhr
ab	Bremerhaven Hbf	17:36 Uhr	an	Bremervörde	18:20 Uhr
ab	Bremervörde	18:32 Uhr	an	Buxtehude	19:16 Uhr
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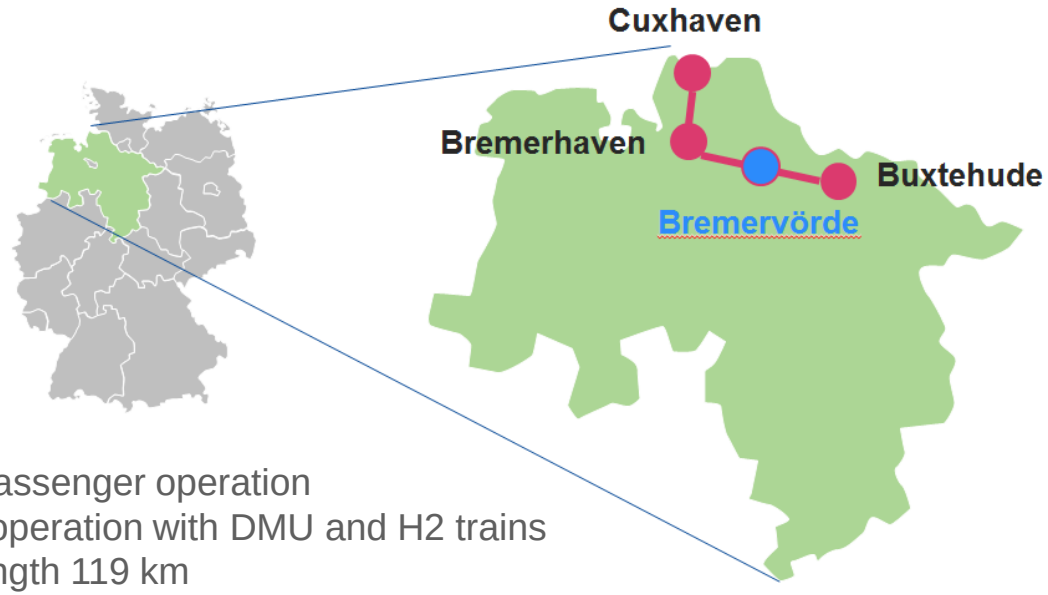
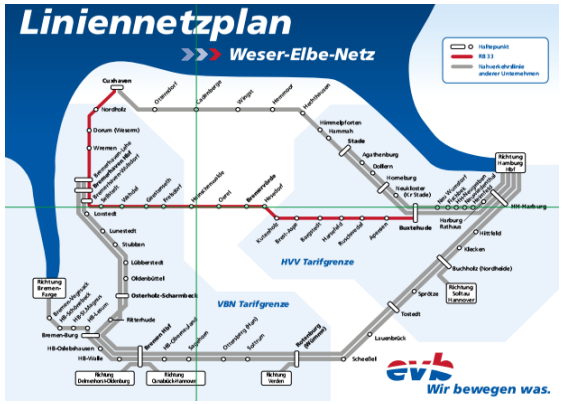


- Daily passenger operation
- Mixed operation with DMU and H2 trains
- Line length 119 km
- One mobile refueling station in Bremervörde
- More than 150.000 km



Operated by EVB (local operator)

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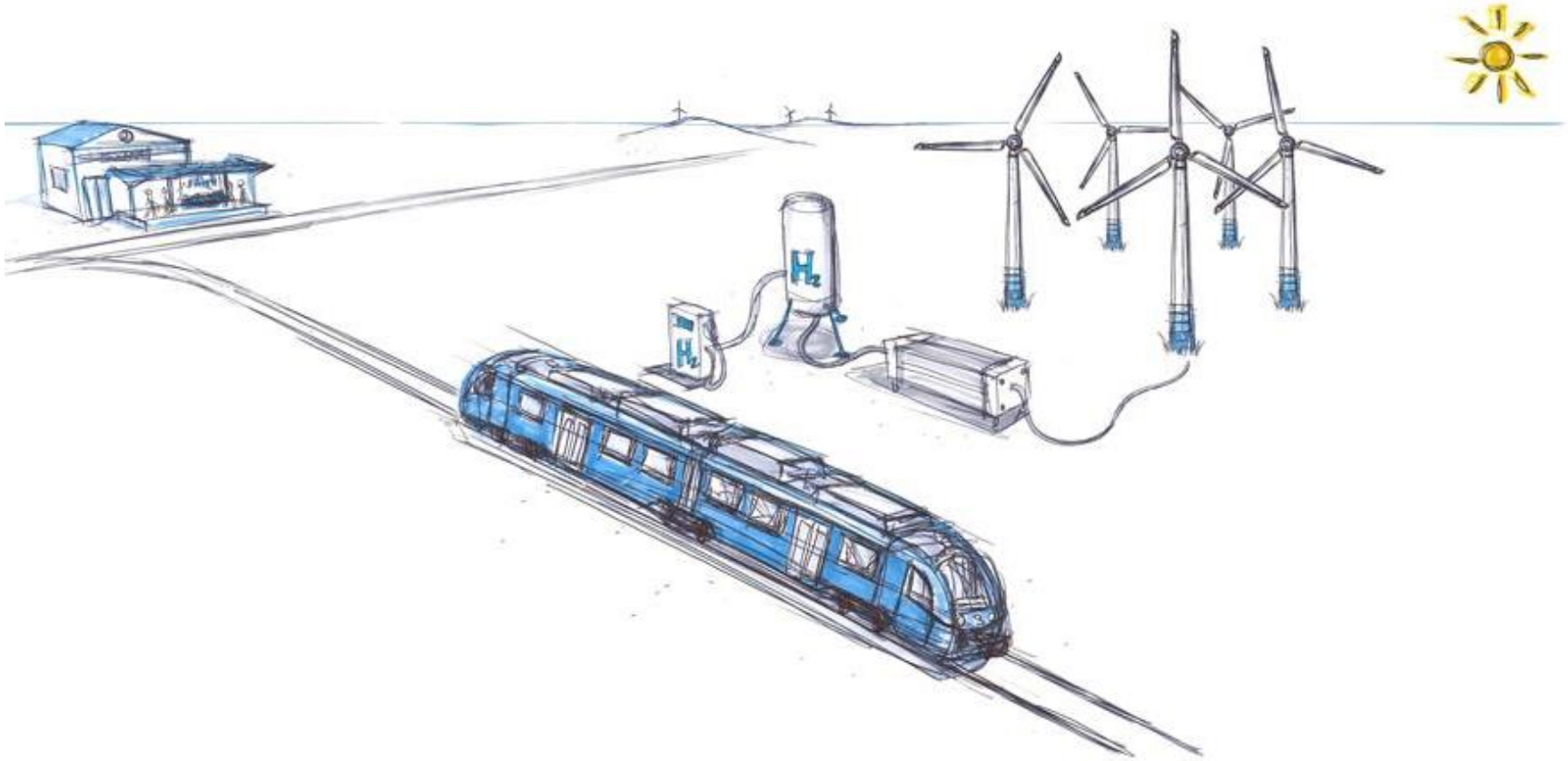
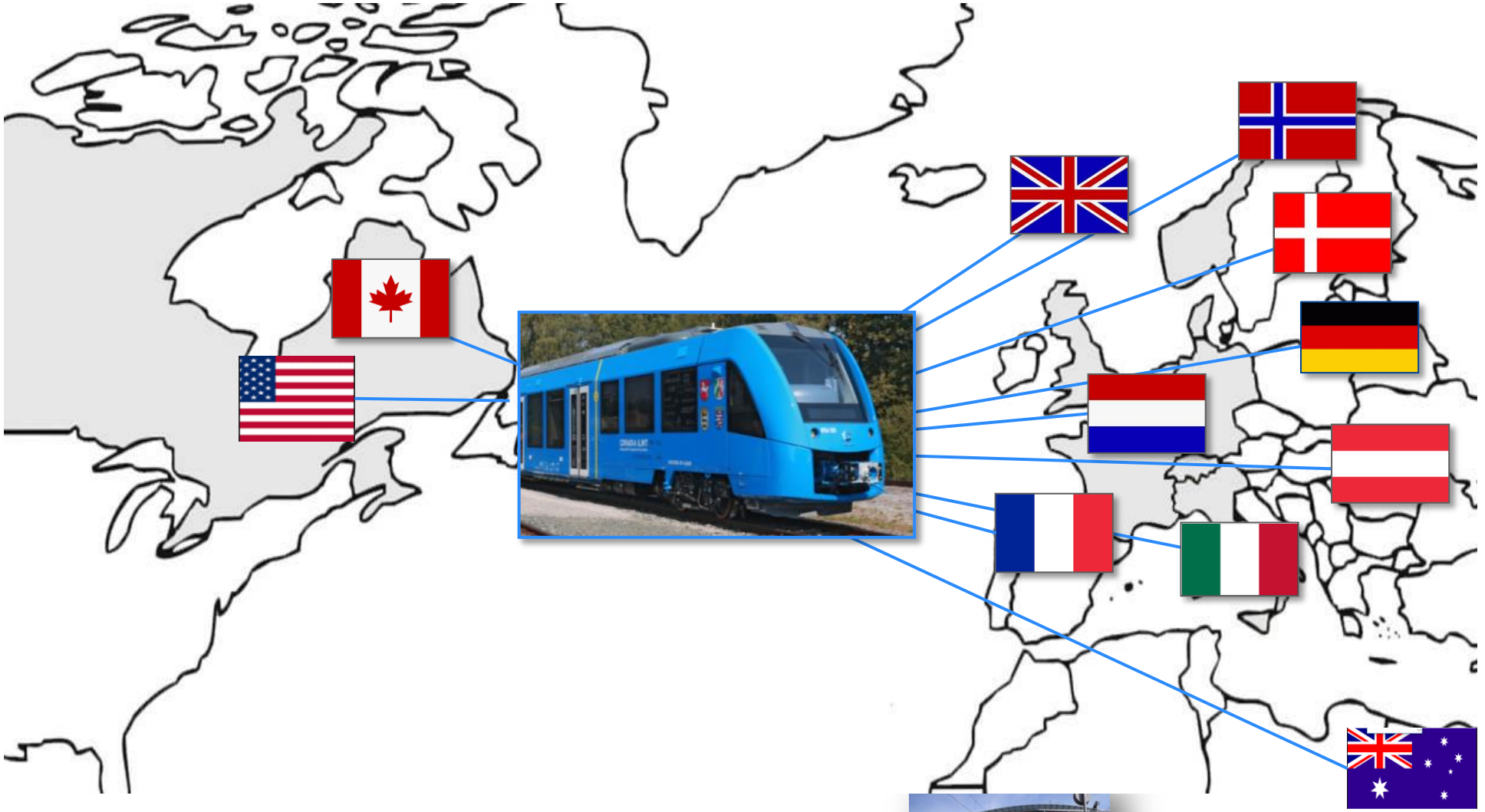
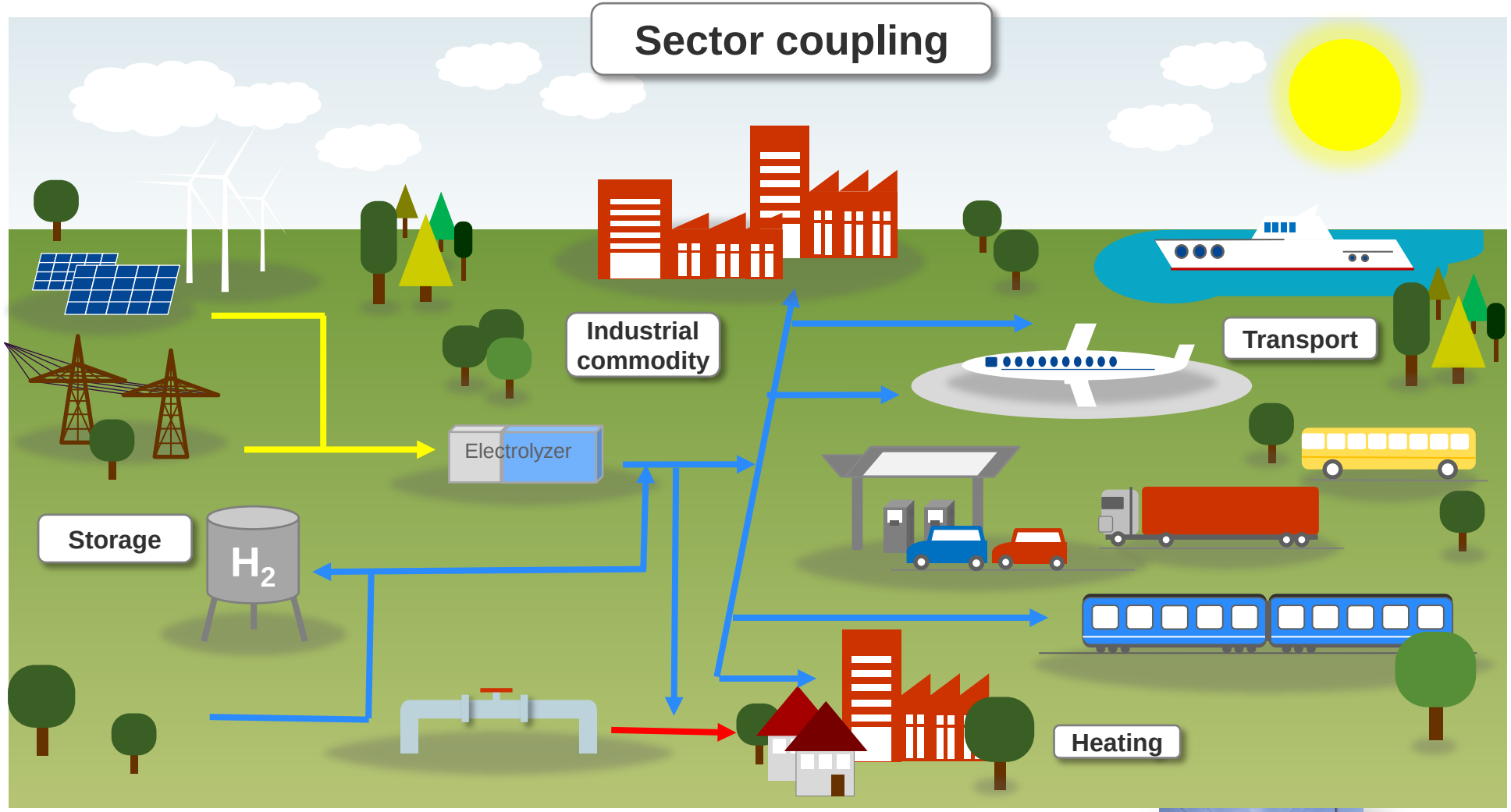
Hydrogen supply: Regenerative – Grid use/balancing



Next steps: Introduction of HFC Rolling Stock in….



Vision / Strategy for successful implementation of Hydrogen



Thank you for your attention

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