



Hydrogen as the key for emission-free rail transport – opportunities and challenges

Michael Ritter – May 15th, 2017

Today, Alstom is offering a full range of products and services for the growing rail market

Trains



Services



Systems



Signalling



32,000 employees
working on **105**
sites in **60**
countries serving
200 customers

Several drivers force the rail sector to seek alternative fuel technologies



Significant part of the **rail network not electrified** (e.g. Germany: 40%)

Emission-free trains
for lines without
catenary



Increasing prices for **diesel** and **traction current** in the medium and long term

Alternative to fossil
fuel



Legislation and expectations on **air quality** and **noise reduction**

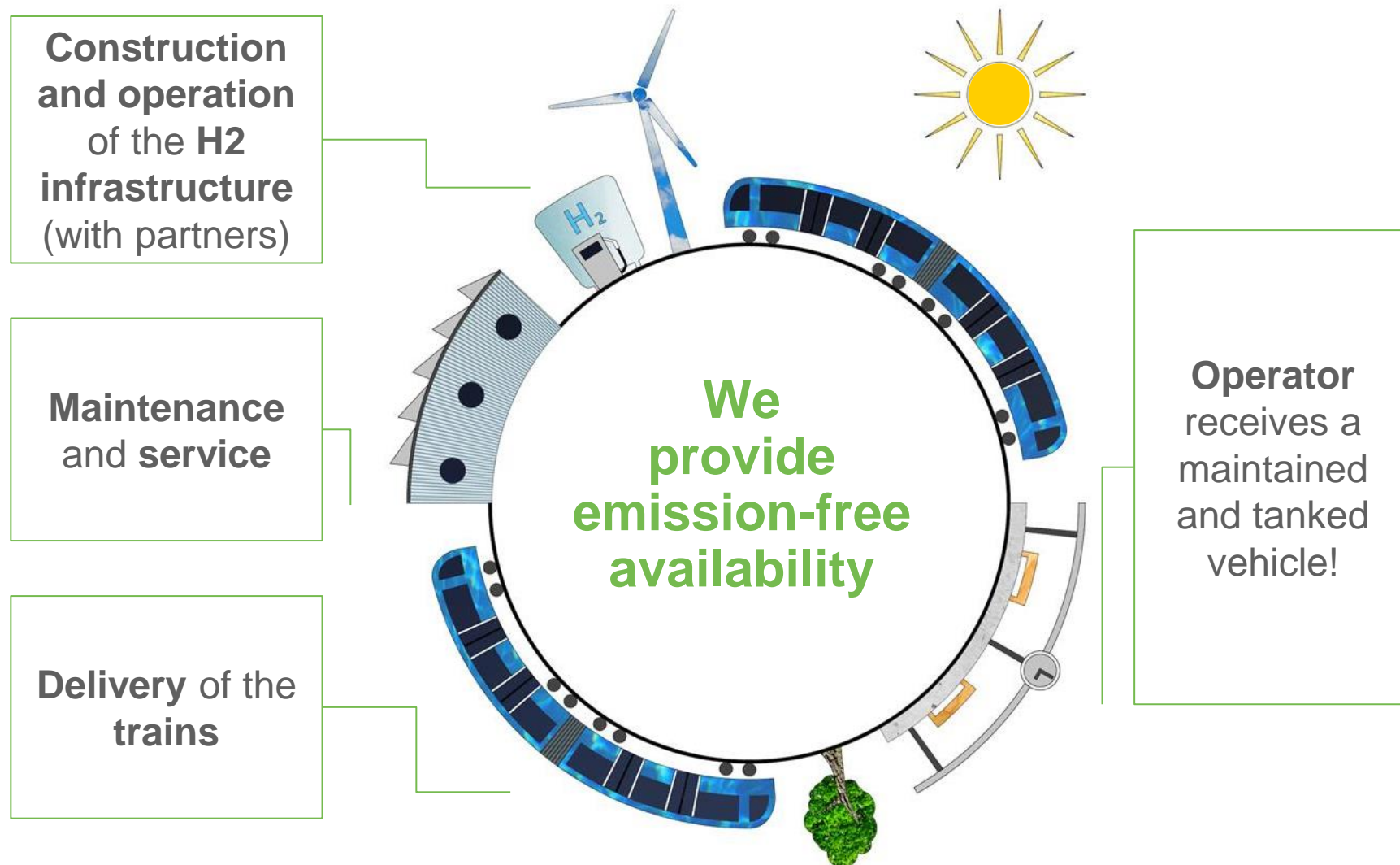
Emission and noise
reduction



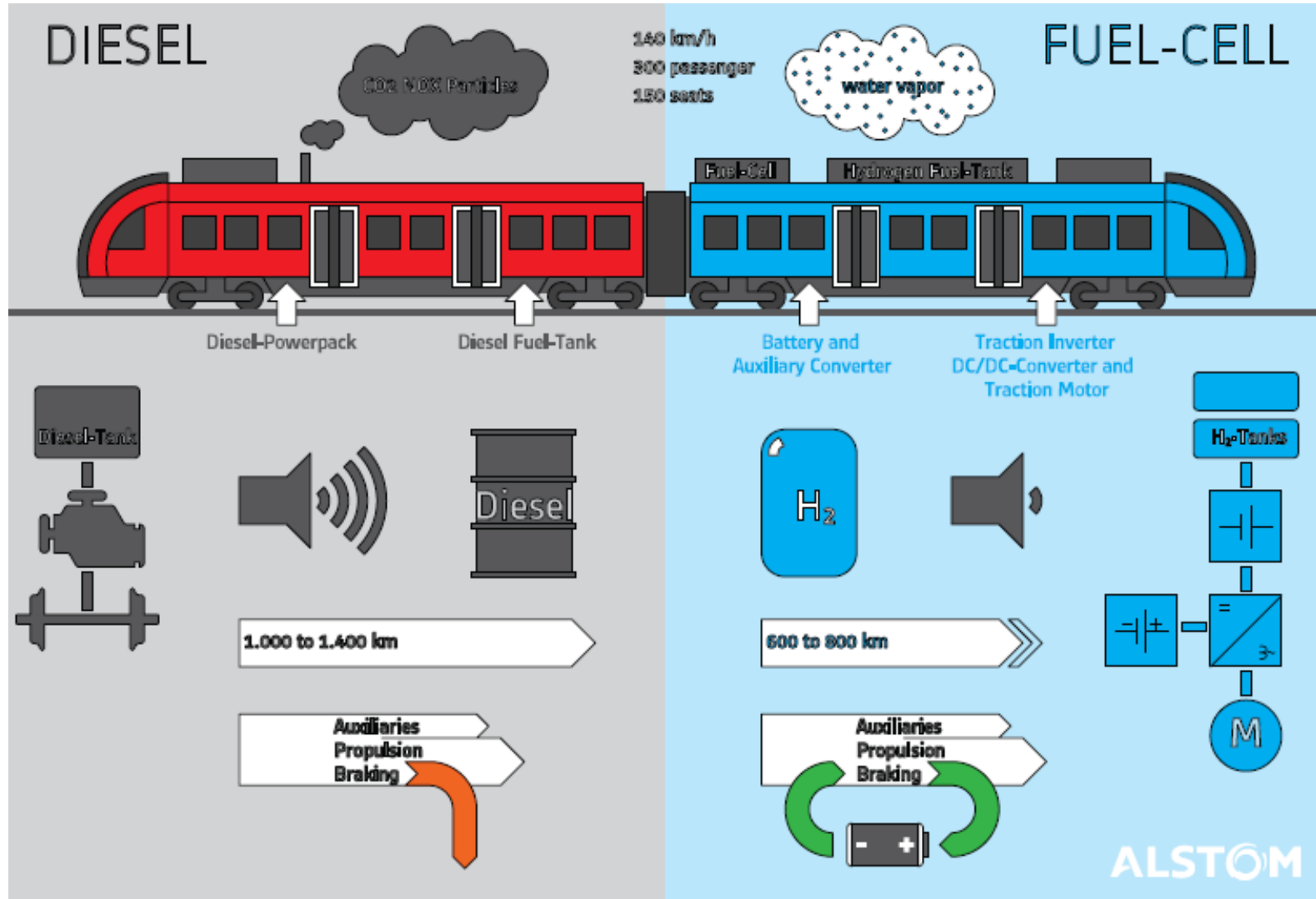
Less acceptance and political discussion about **ban of diesel** in **urban areas**

Compliant
technology

The vision: Our customers receive emission-free train availability



Alstom answers this challenge with the hydrogen powered Coradia iLint

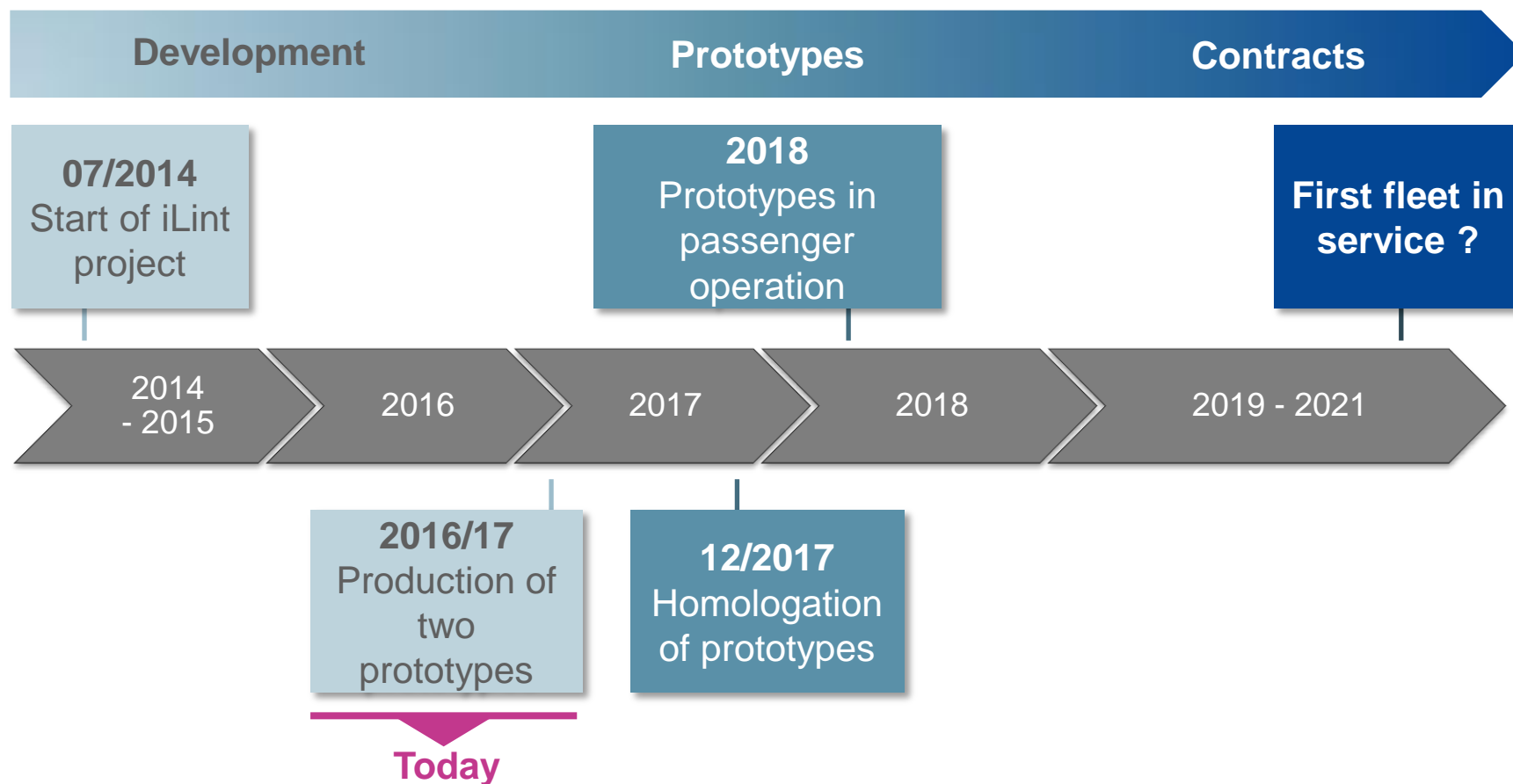


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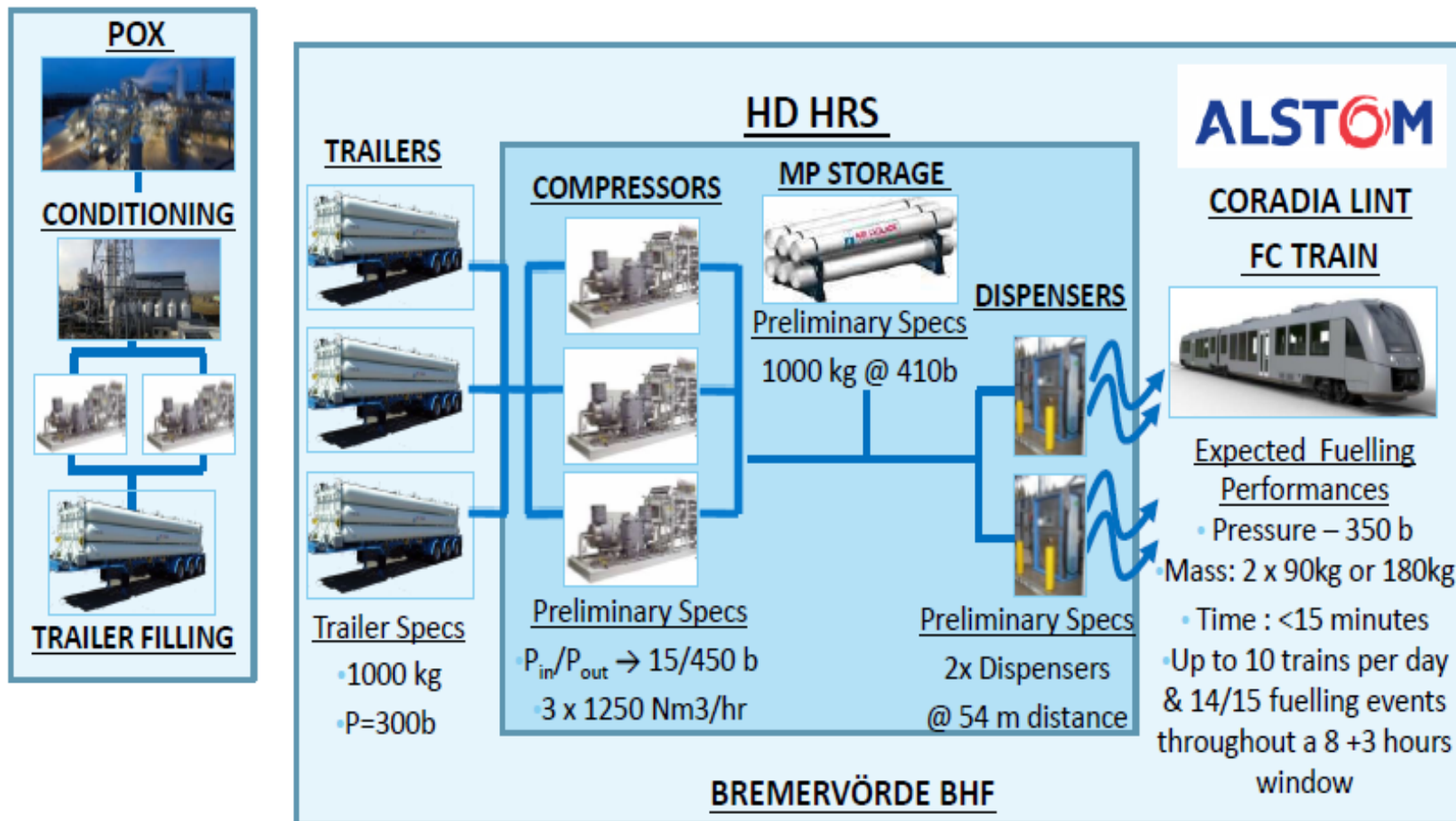
Coradia iLint was presented to the public at InnoTrans in Berlin in September 2016



Currently, Alstom produces two prototypes – in operation by end of 2017

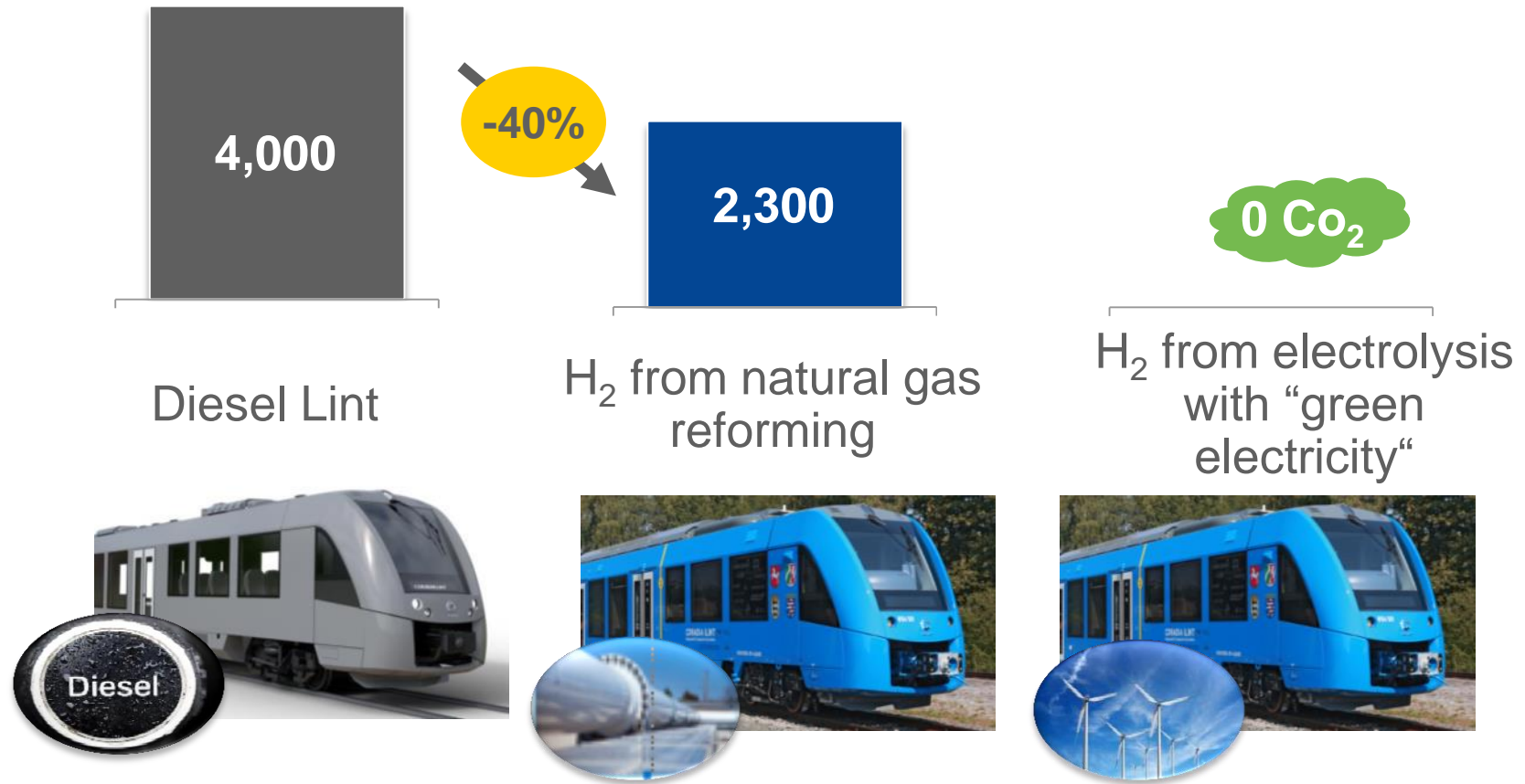


First project will rely heavily on hydrogen from existing sources – “grey” hydrogen



First steps towards zero emission with „grey“ hydrogen – future solutions have to rely in „green“ hydrogen“

CO₂ emission per vehicle km (in gramme)



With green hydrogen, one iLint saves about ~700t of CO₂ per year, a typical fleet of 15 trains more than 11.000t



minus
700t CO₂
per year...



...corresponds to the
annual output of
400 cars



Saving per iLint



minus
11,000t CO₂
per year...



...corresponds to the
annual output of
6,000 cars



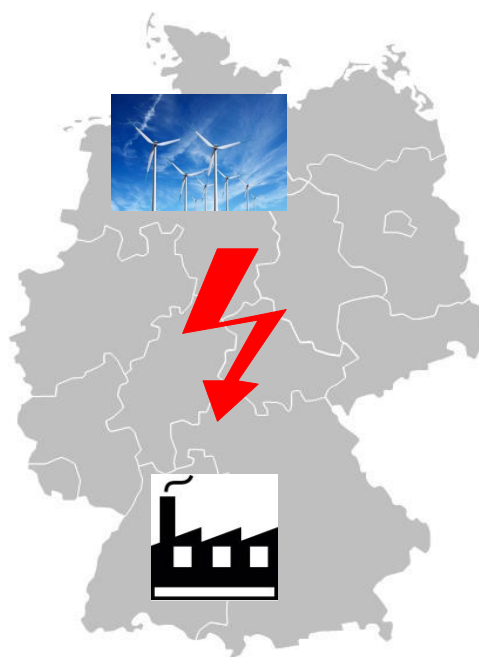
Saving per iLint fleet

Local usage of wind energy provides solution to increasingly overloaded electricity grids

As **capacity** of renewable energy **grows**...

... **electricity grids** are increasingly **under stress**.

Solution: **Local usage** of green electricity for **electrolysis**



10 MW of wind power are necessary to power a 4MW electrolysis plant for 15 iLints

About **10 MW** of wind power necessary...



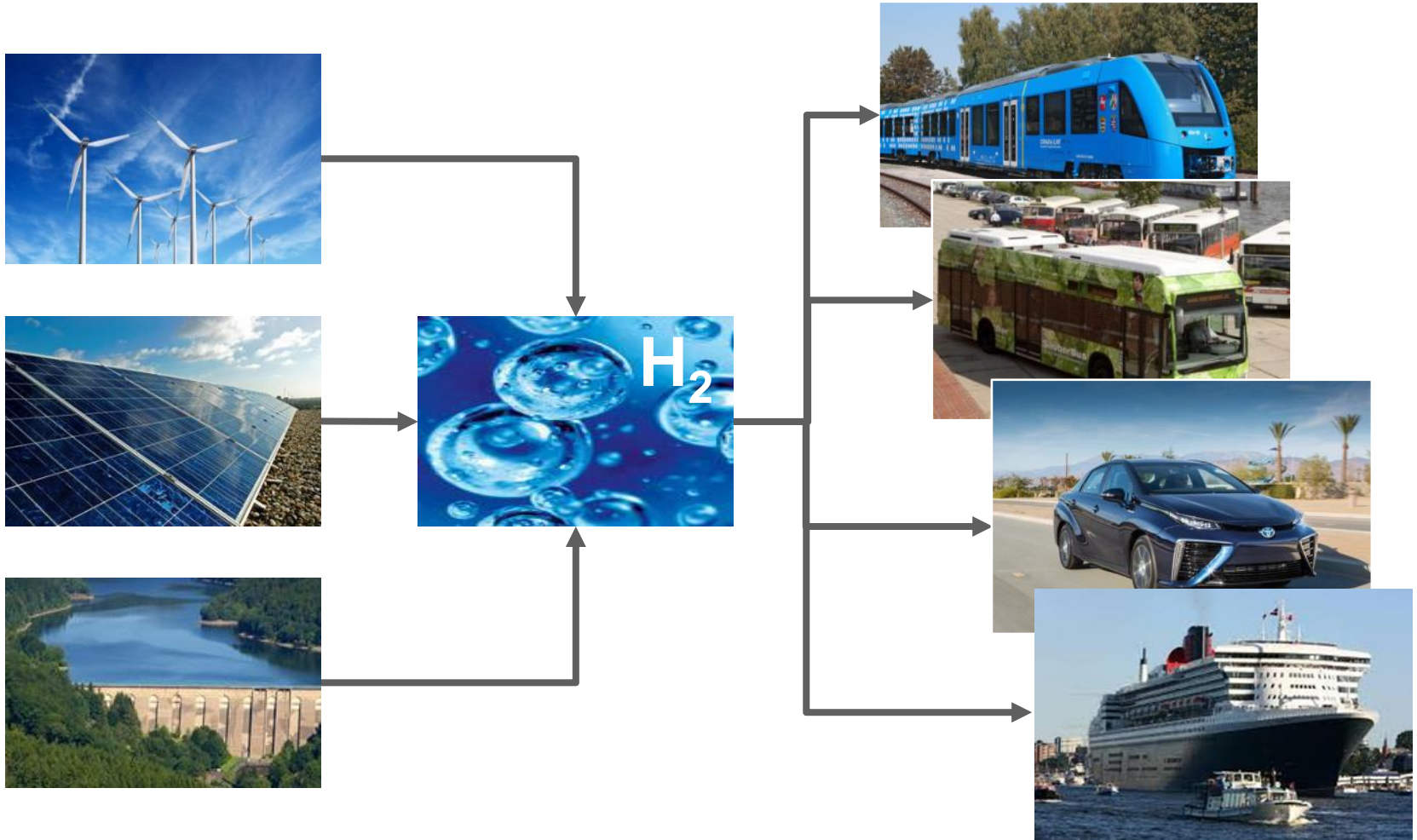
...to power a **4 MW** electrolysis plant...



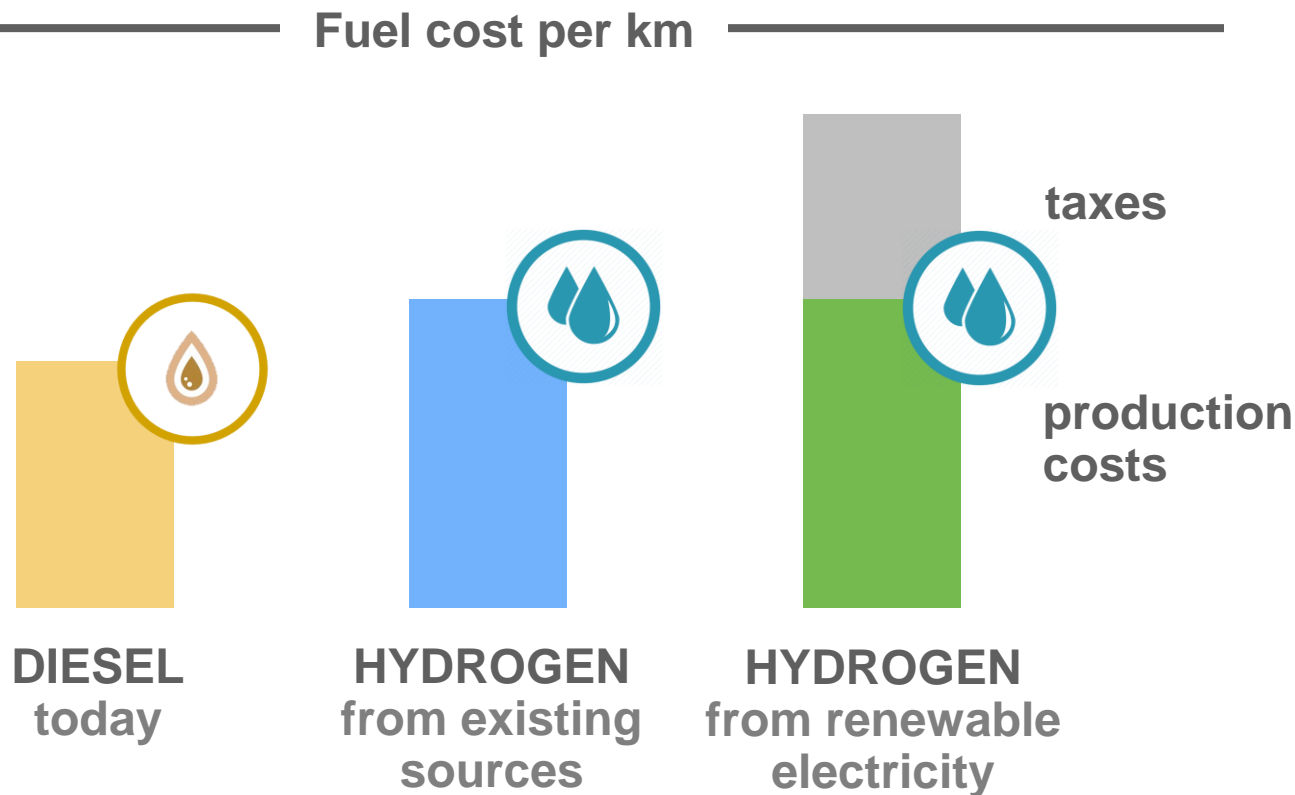
...to run a fleet of **15 iLints!**



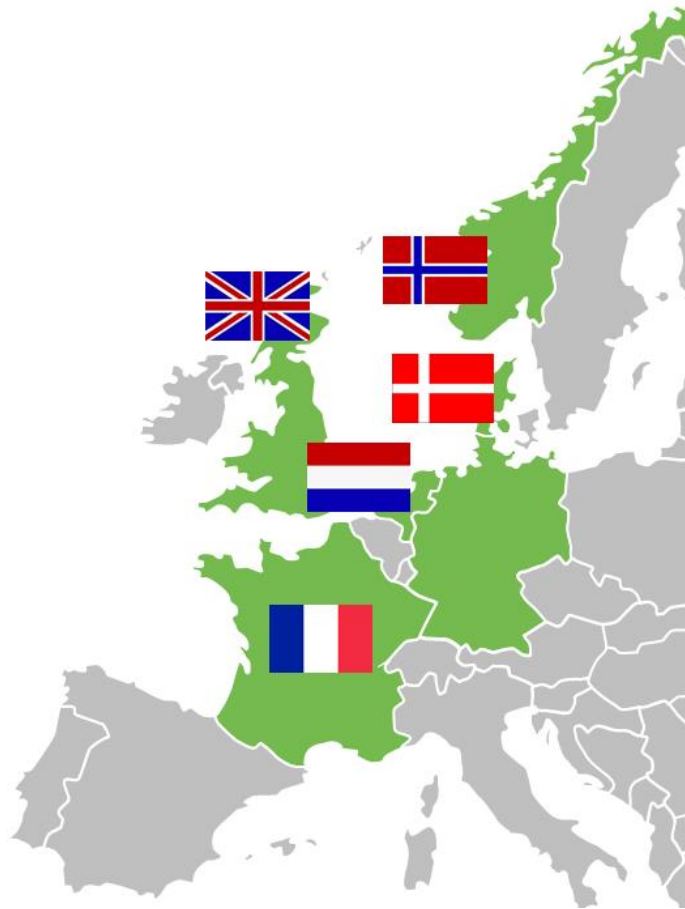
Green hydrogen as a basis for further environmentally friendly transport solutions



Current taxes and other charges impede the competitiveness of true green hydrogen



Also ideal prerequisites for emission-free public rail transport in other European countries



- Ambitious climate protection goals
- Trendsetting traffic management
- High potential in energy generation
- Local hydrogen production
- Cross-border traffic → European funding

Summary

- Hydrogen and fuel cell technology are ready to be employed for large scale rail application
- First two prototypes in operation in Lower Saxony / Germany starting end of 2017, negotiations for several other projects in progress
- Hydrogen from windparks is an important module to switch to a carbon-neutral economy
- Wind energy only part of the solution – current regulatory framework inflates costs
- More common steps necessary to realize full potential of green hydrogen



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