Hydrogen Industry Leader's Conference

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Product Manager

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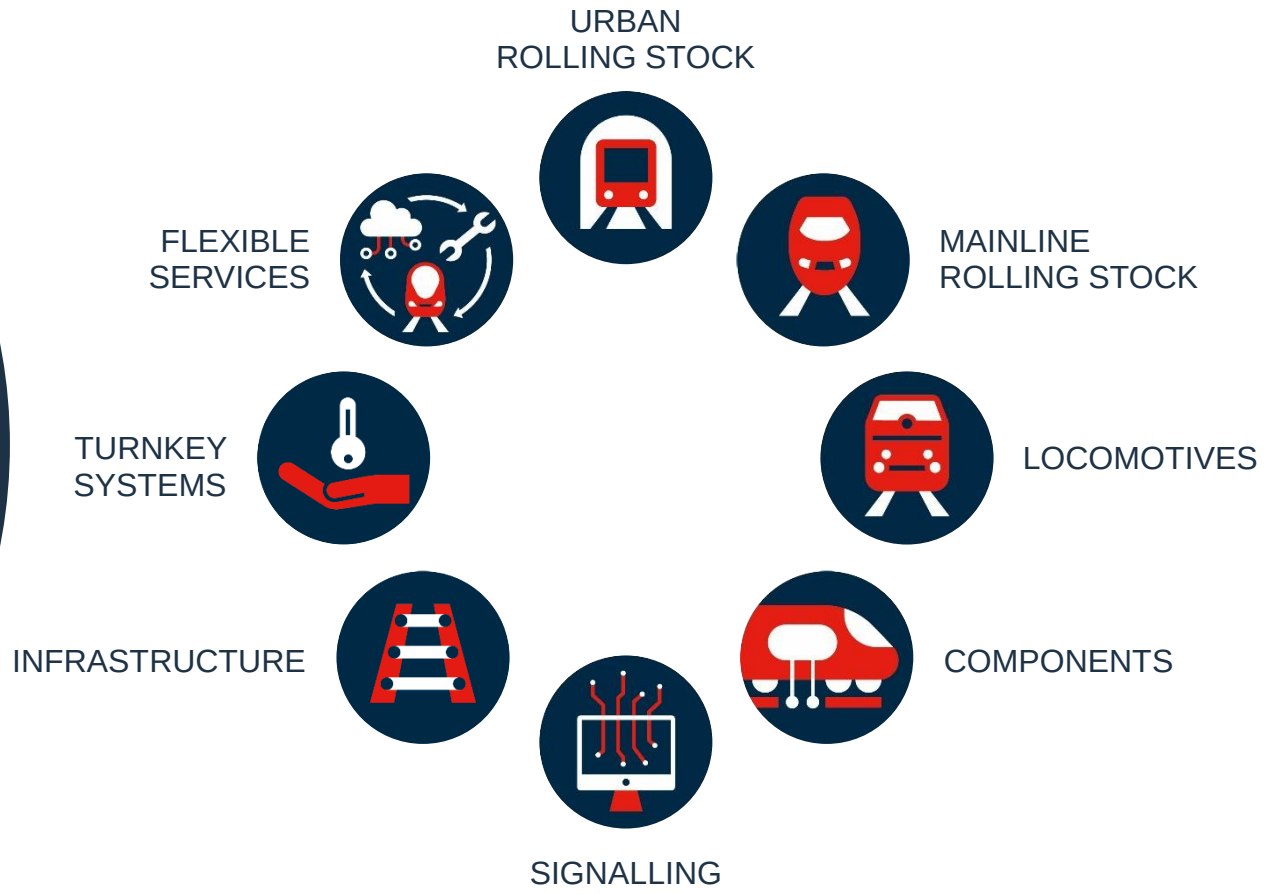
Who are Alstom?

A global leader in the transportation sector in the digital age

Leading societies to a low carbon future

Alstom develops and markets mobility solutions that provide sustainable foundations for the future of transportation.

Our comprehensive product portfolio ranges from high-speed trains, metros, monorail and trams, to turnkey systems, services, infrastructure, signalling and digital mobility solutions.



33
Locations across UK&I

#1
UK Rolling Stock & Services

6,000
UK&I Employees

Rolling stock | Services | Signalling | Systems

Staff **6,200**

12.9% of all employees are female (18.9% of MEPs are female)

AVERAGE AGE 43 years

Largest UK train factory + biggest in Alstom by output

50% UK rail journeys on an Alstom train

Large sites **4**

depots **24**

London Underground and Overground trains **100%** **Alstom-made**

MAJOR signalling and infra business

66% UK fleet supported from **Pendolino** to **Crossrail**

1.5bn–2bn pa REVENUE / ORDERS

22 years in Scotland with Juniper

109 Scottish jobs

Maintenance and train refurbishment at Polmadie

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COP26 Glasgow – Playing our part

- Scottish Government: “We want travel in Scotland to be clean and green. Our ambition means that we are already committed to going further and in some cases, faster than some of the agreements concluded during COP26.”

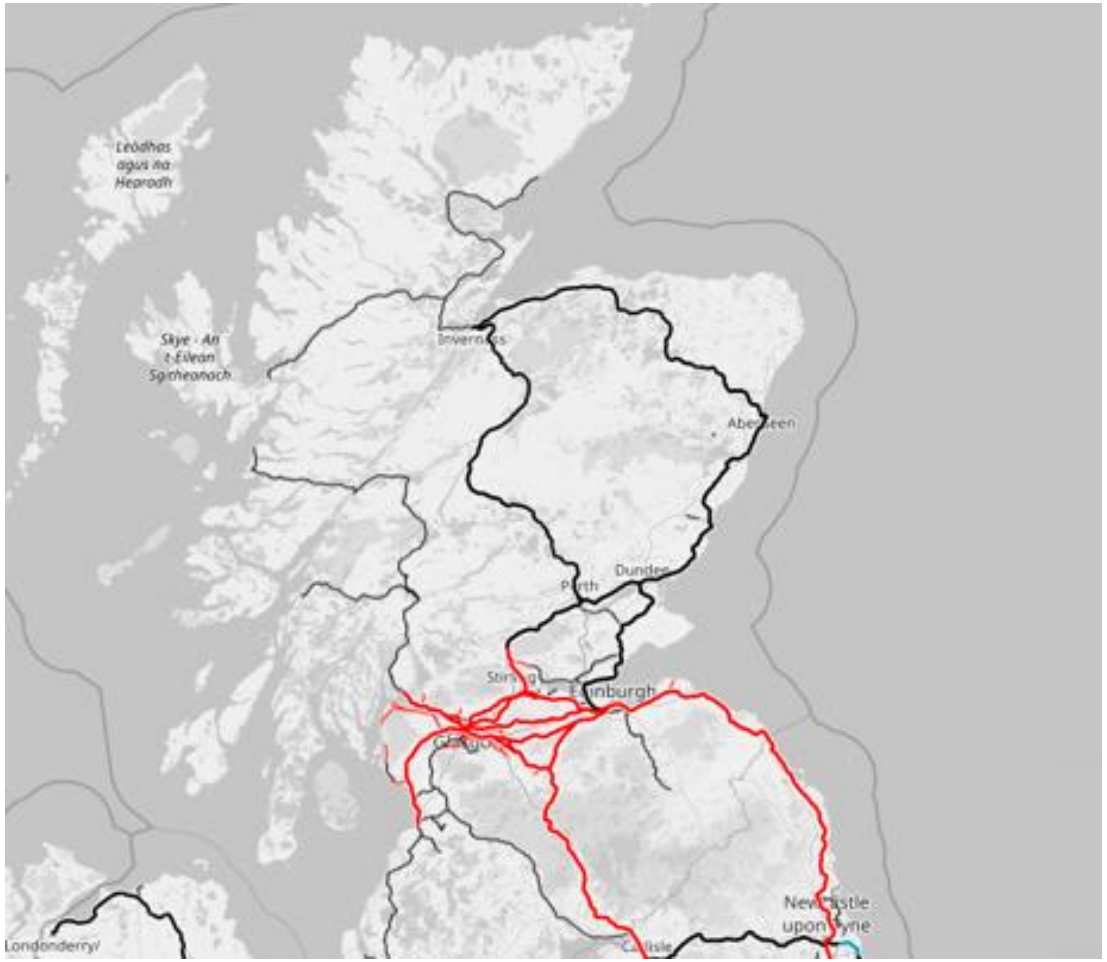
Scottish rail transport today

Where are we today?

- **~60% of the Scottish network is non-electrified.**
  - Indication is that some lines could remain non-electrified for the next 40 years.
- **Aging Diesel Rolling Stock**
  - (Second Generation Diesels) need urgent replacement
  - Scotland aspires to remove all Diesel Only Trains by 2035, 5 years ahead of England

Overall UK rail industry emissions

	CO_2e (000 tonnes)	% of total
Total	**5,700**	
Traction energy	**3,600**	**63%**
Diesel (gasoil)	2,100	37%
Electricity	1,500	26%
Staffing and services	**175**	**3%**
Staff and offices	81	1%
Services	93	2%
Subsystems	**1,920**	**34%**
Track	490	9%
Rolling stock	165	3%
Stations	223	4%
Depots	539	9%
Structures	229	4%
Electrification	44	1%
Train control systems	233	4%



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Replacement Technologies

How can we remove these diesel trains from the network?

Electrification

- Most efficient form of energy supply
- Expensive infrastructure costs

Traction Battery

- Cost effective solution
- Limited Range
- Perfect for short distances

Hydrogen

- Similar performance to existing diesels
- Novel Technology with unique requirements
- Perfect for longer distances

Recommended for:

High Traffic
High Speed or High Station Stop Frequency

Short non-electrified sections

Low Traffic
Direct Diesel Replacement

There is no ‘one-size fits all’ solution anymore

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Alstom’s Hydrogen Projects

734 miles

without refuelling

WORLD RECORD RUN

14

Units already in passenger service and more to come!

0

Carbon emissions produced

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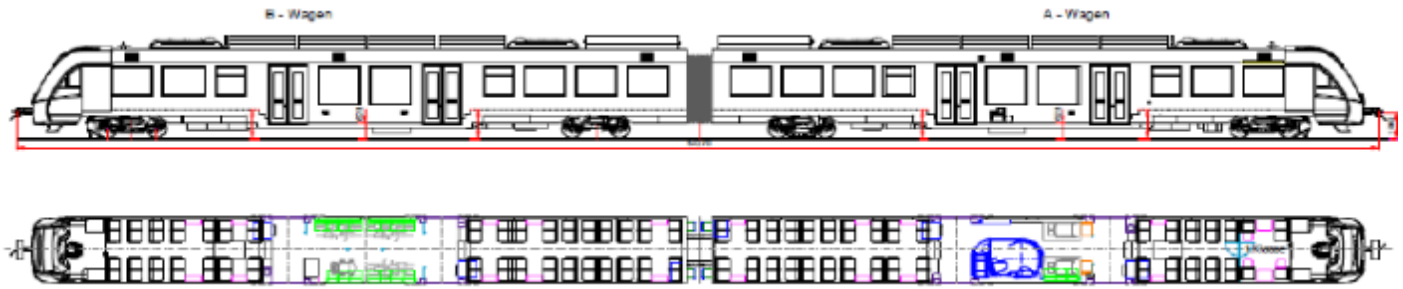
What are the capabilities of hydrogen trains?

- Suits regional (and inter-city), passenger services
- Zero emissions from the train
- Range >700 miles
- Speeds up to 100mph
- Battery hybrid drive uses regenerative braking energy
- Performance matches today’s diesels
- Refill times & process similar to diesel
- All-weather capability
- System introduction without service impact

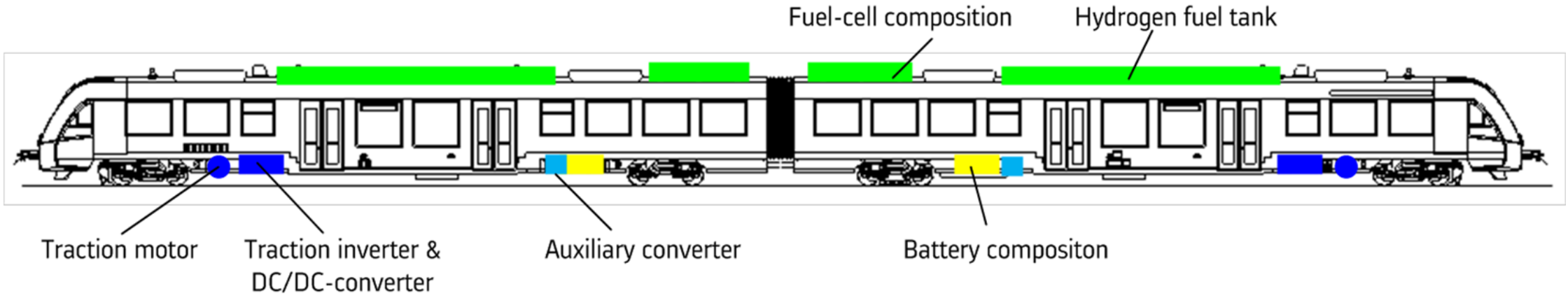
Alstom’s Coradia iLint

Coradia iLint - Regional train

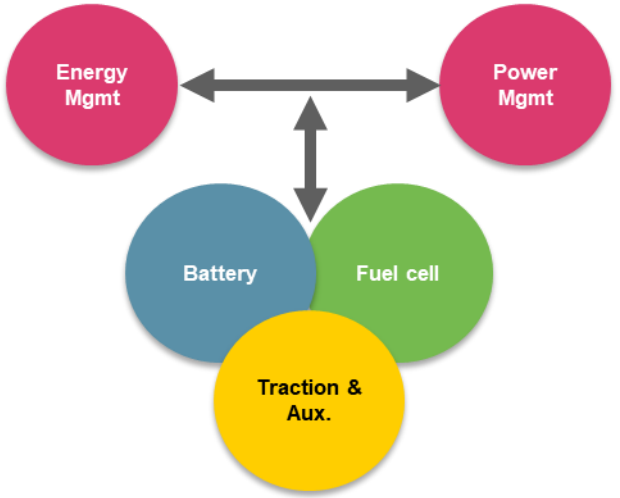
- Based on Alstom Coradia Lint 54 DMU
- Low floor train
- Higher acceleration than Diesel Variant
- Max. speed 140 km/h
- 150 seats
- 1 toilet
- Flex area
- Zero emission at point of use
- Less noise



The Coradia iLint – how it works



- Diesel traction replaced with electric traction system
- Primary energy supply from hydrogen fuel cells
- Intermediate energy storage from Li-Ion batteries
  - to boost during acceleration
  - to recover kinetic energy during braking
- All electric auxiliary supply



Hydrogen trains ordered to date

55 trains ordered so far…

- **Coradia iLint (Germany)**
- 41 trains ordered in two fleets
- Entered full service Q1 2022
- Pre-series trains in passenger service **since 2018**

- **Coradia Stream (Italy)**
- 6 trains plus 8 options
- Fleet to deploy in Lombardy
- Enters service Q4 2023

Hydrogen trains ordered to date

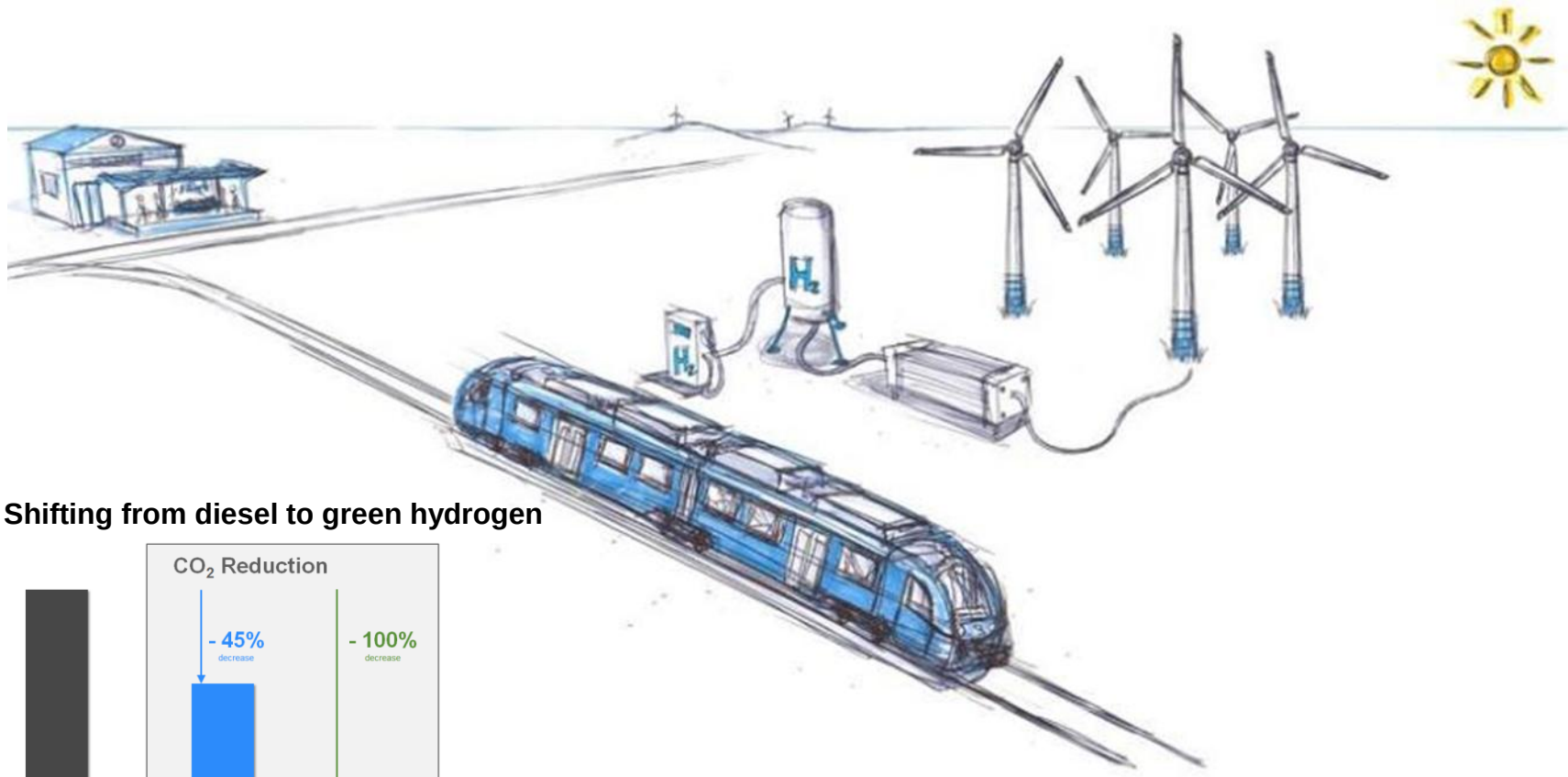
Being actively tested by …

- **Austria**
- **The Netherlands**
- **Poland**
- **Sweden**

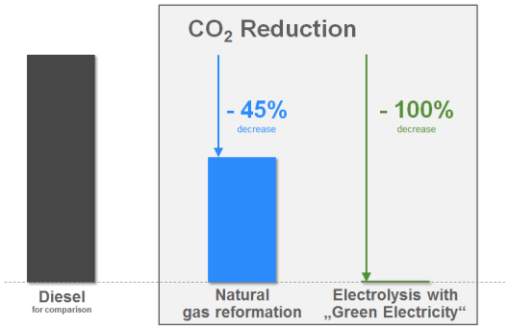
Alstom new-build hydrogen solution for the UK with enhanced technical package in development

Established Technology repackaged for the UK Market

However, achieving “zero emissions” will take more than just the train



Shifting from diesel to green hydrogen



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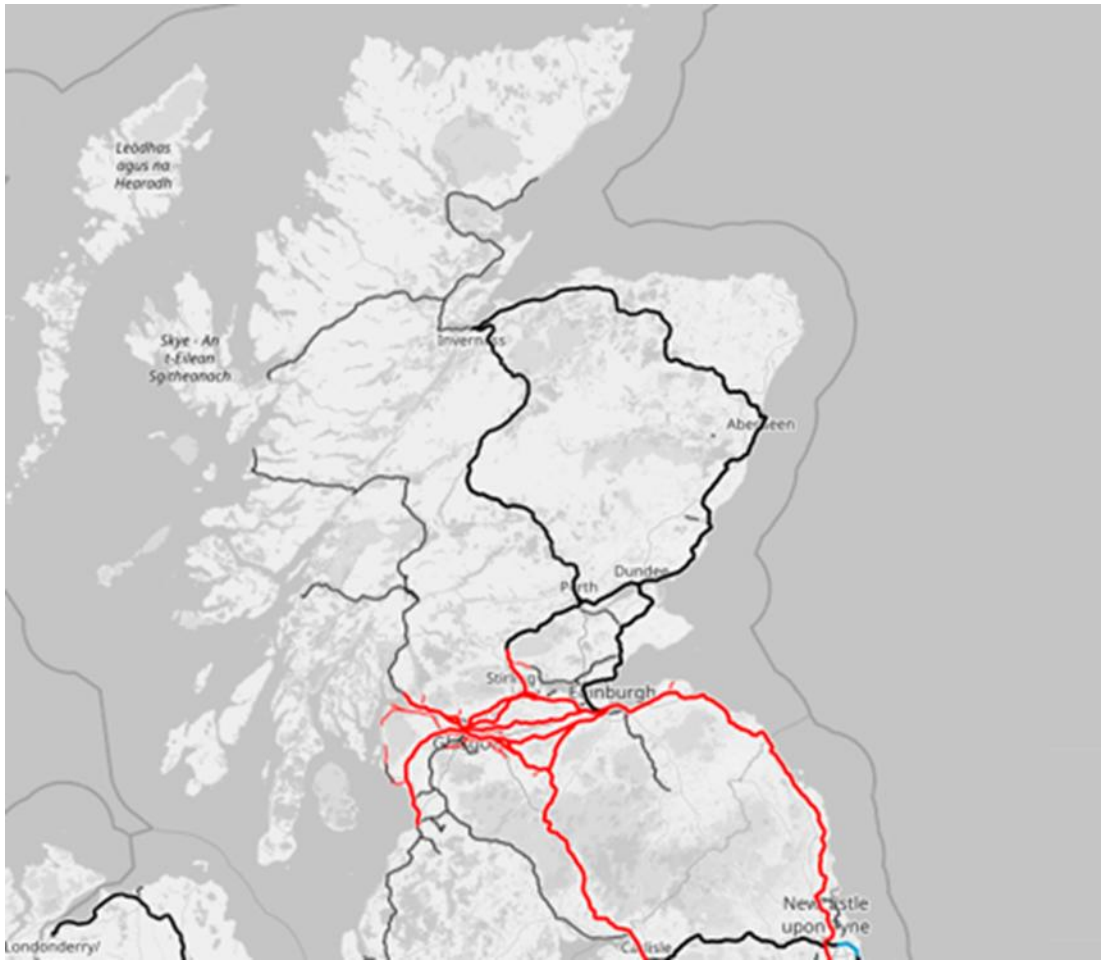
Rail can be an early adopter for the H2 economy to propagate its growth

Take away facts

- 734 miles on one tank of hydrogen
- Zero emissions
- Same EMU and BEMU platform
- Rail can be an early adopter for the H2 economy to propagate its growth
- Strong partnerships around the world.
- Ready now



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