ZERO EMISSION TRUCK BRIEFING ROUNDTABLE

Novuna® Vehicle Solutions

Freight carbon zero

MotorTransport

AGENDA

11:00	Welcome: Andy Salter, Freight Carbon Zero Project introduction: James Bligh, Novuna Vehicle Solutions Energy infrastructure and distribution: Henry Story, Exolum Hydrogen Fuel Cell explanation: John Winterbourne, Ballard Introducing the vehicles: Sharon van Beek, Utz Rachner, Quantron AG Data and project outputs: Huda Dawood, Teesside University
11:45	Panel discussion and audience Q&A
12:30	Networking lunch

Novuna® Vehicle Solutions

Freight carbon zero

MotorTransport

James Bligh

Novuna Vehicle Solutions

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Freight carbon zero

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Briefing Presentation

Tees Valley Hydrogen Transport Project

Novuna®
Vehicle Solutions

Tomorrow. **Together**

Novuna Vehicle Solutions provides bespoke vehicle funding and fleet management services for business vehicle leasing, specialist commercial vehicles and personal contract hire

We provide Total Asset Solutions with EV and Alternative Fuel & Charging choices for our customers across all vehicle types:

Our Strength in Numbers

450
Vehicle Solutions UK based staff

110,000
Vehicle fleet across the UK (March 2024)

55%
Funded Fleet growth 2018 –2023

Our Strength in Strategy

Decarbonisation
Transform our fleet to net zero by 2030

Customer First
Everything we do starts and ends with our customer

Optimise
Improving on what we do today

Our Values: Pioneering Spirit, Sincerity, Harmony

Our Promise: To unlock the potential of individuals, businesses and society, by delivering innovative solutions and outstanding customer experiences

FleetNews AWARDS 2024 WINNER Leasing Company of the Year: more than 20,000 vehicles
FleetNews AWARDS 2024 HIGHLY COMMENDED Fleet Supplier of the Year
FleetNews AWARDS 2023 HIGHLY COMMENDED Leasing Company of the Year: more than 20,000 vehicles
FleetNews AWARDS 2022 WINNER Leasing Company of the Year (more than 20,000 vehicles)
FleetNews AWARDS 2021 WINNER Leasing Company of the Year (more than 20,000 vehicles)
FleetNews AWARDS 2020 WINNER Leasing Company of the Year More than 20,000 vehicles
FleetNews AWARDS 2019 WINNER Leasing Company of the Year More than 20,000 vehicles

Decarbonisation is our number one strategy and is underpinned by our Customer First Culture

Tomorrow. Together

Department for Transport

The Department for Transport (DfT) has confirmed that a zero emissions vehicle (ZEV) mandate, will require more than a fifth (22%) of cars and 10% of vans sold by manufacturers to be electric, will come into force next year.

Business Secretary Kemi Badenoch indicated to the BBC last week, that electric vehicle (EV) sales will be targeted from 2024 and increase each year thereafter.

Today, the transport secretary, Mark Harper, confirmed the detail around targets for manufacturers which will increase each year, requiring 80% of new cars and 70% of new vans sold in Great Britain to be zero emission by 2030, increasing to 100% by 2035.

The ZEV mandate requiring 100% of new cars and vans to be sold to be electric by 2035, comes after the Government decided to delay the ban on the sale of new petrol and diesel cars and vans by five years, from 2030 to 2035.

Vehicle makers that fail to achieve the ZEV mandate sales targets will be subject to fines, with a system of proposed flexibilities and credits to support those that sell a low volume of EVs.

If a company misses the target, it will be made to pay the Government £15,000 for every car that doesn't comply. For vans, manufacturers will have to pay £9,000 per vehicle next year, before the van payment increases to for the rest of the regulation's timeframe.

While the DfT has amended the trajectory originally suggested for electric van sales, it says that it still considered it appropriate to proceed with a 10% target from 2024.

The measures, say the DfT, give the wide range of manufacturers flexibility through a trading scheme, enabling them to bank compliance in years when they exceed annual targets for use in future years or trade them with other manufacturers that have fallen short. In the first-year car manufacturers can borrow for up to 75% of their annual target, falling to 25% in 2026, to support them in the early stages.

Annual car targets						
2024:22%	2025:28%	2026:33%	2027:38%	2028:52%	2029:66%	2030:80%
Annual van targets						
2024:10%	2025:16%	2026:24%	2027:34%	2028:46%	2029:58%	2030:70%

Why Teesside

Teesside is a major UK hydrogen development area and the leading green hydrogen zone in the UK. This comes after the UK Government announced its multi million investment in eesside to develop ees alley as the UK's first ever hydrogen transport hub

eesside will play a big part in UK overnment's meeting net ero targets through developing a Green Hydrogen Hub for Teesside. This project will provide Teesside with clean, green energy, as well as ensuring Teesside remains a historic Powerhouse. It will also create opportunities for the local community and enrich the area eesside's energy transition is a leading example for other carbon intense regions to follow, as the green cluster is allowing various industries to decarbonise, especially hard to abate sectors such as transport.

Tees Valley University Net Zero Innovation Centre

Teesside

Department for Transport

UKRI Innovate UK KTN

HYVE Consortium

ERM **Consortium Lead**

UK Government funding competition in the form of a Grant to help fund and operate Hydrogen vehicles in the Tees Valley area

Criteria

Demonstrate submitted and planned hydrogen transport solutions by 31 March 2025 for a minimum of 6 months with the expectation of continuing operations commercially after this period.

Be part of the project to supply and track FCEV vehicle performance against stated metrics to understand benefits or challenges for the benefit of other UK regions.

Report on the benefits of operating Hydrogen vehicles and refuelling infrastructure for, customers and residents in the Tees Valley area.

Develop plans for long-term activities to create a demand for hydrogen vehicles in the Tees Valley from 2025.

exolum

Infrastructure Hydrogen Fuel Station

NET ZERO INDUSTRY INNOVATION CENTRE

Teesside University

Project Monitoring Evaluation Insight

Novuna® Vehicle Solutions

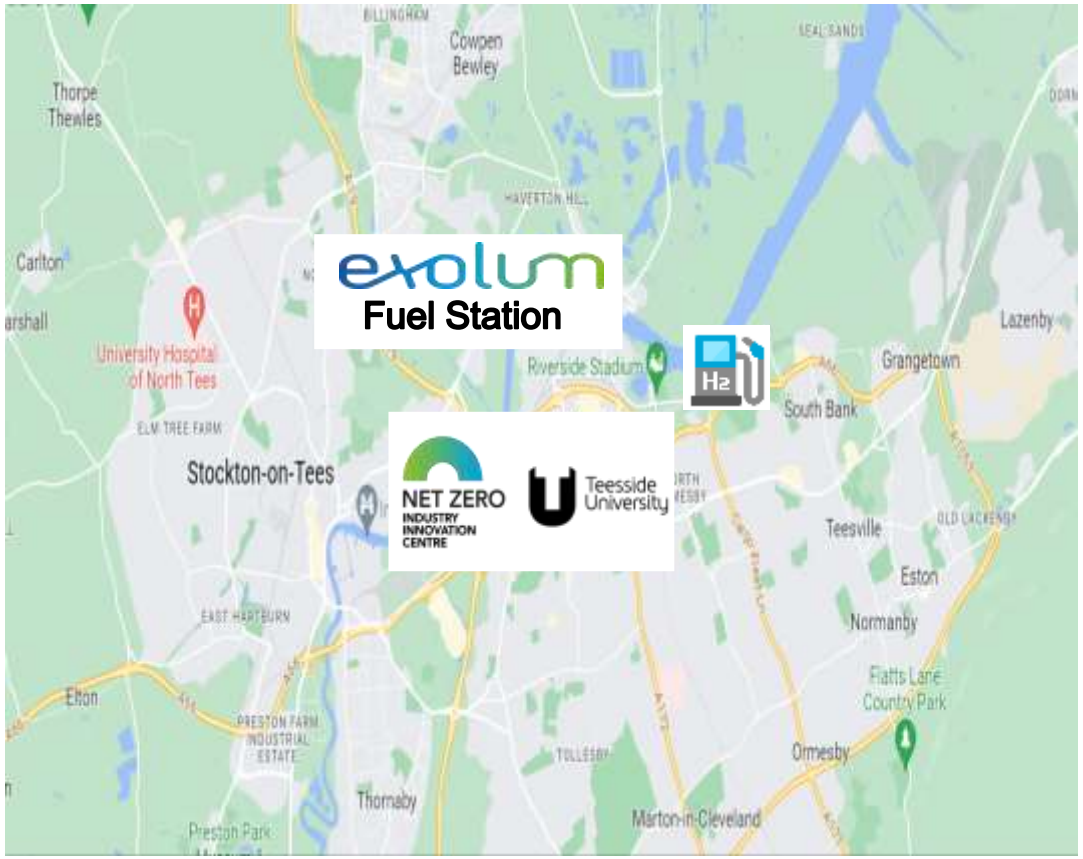
FCEV Vehicle Leasing Company

QUANTRON

FCEV Vehicle Manufacturer

Note:- FCEV = Fuel Cell Electric Vehicle

Teesside New Hydrogen Fuel Station Location



QUANTRON

Quantron will Build - Total up to 20 FCEV Vehicles

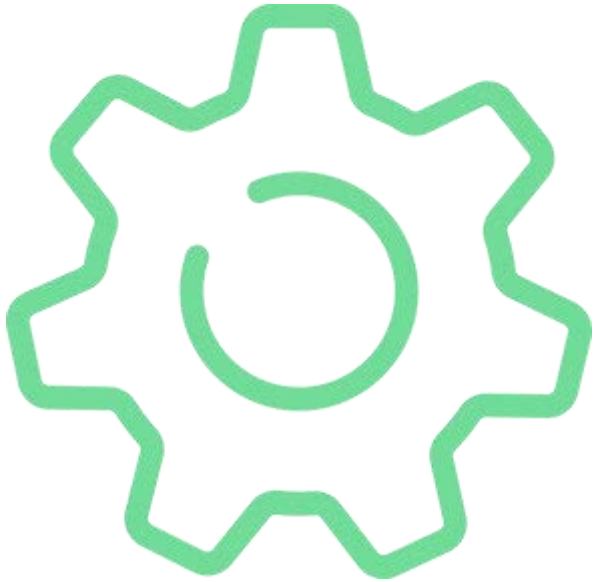
4.2t Distribution

7.2t & 19t Infrastructure

7.2t & 19t Distribution

19t Refrigerated

- Working with Quantron & the Customer - Design and Build Vehicle Specification
GVW - Chassis - Bodywork - Ancillary - Payload - Range
- Comprehensive TCO price modelling - Lease with Maintenance Pricing
- Build Management - Vehicle Delivery & Driver Training Programme
- Project & Customer Implementation Planning
- Fleet & Maintenance Management - Supply Chain Management
- Account Management Framework - Review Meetings - K ’S - Insight
- Working with ERM & Teesside University Evaluate Vehicle Insight
Real life operating conditions - Learnings - Benefits - Challenges etc.



Henry Story

Exolum

Novuna® Vehicle Solutions

Freight carbon zero

MotorTransport

Tees Valley (HYVE) Introduction

Exolum has a large presence in the UK energy sector

Exolum operates critical infrastructure that transports and stores refined products and chemicals

Overview of Exolum's Operations

- Exolum is the leading supplier of bulk product logistics in the UK
- Owns and operates significant infrastructure across the country:
  - 2,000 km of pipelines
  - 24 storage terminals
  - 2,500,000 m^3 of storage capacity
- Handles the following products:
  - Liquid Fuels
  - Gases
  - Chemicals
  - Potable Alcohols and Ethanol
  - Waste products
- Over 600 members of staff around the country

H2Henares – Exolum's hydrogen refuelling station (HRS) in Spain

Exolum will leverage its real-world experience in future deployments of hydrogen production and HRS

Objectives

- Construction and operation of the first on-site green H_2 generation and refuelling plant in Madrid
- Promotion of H_2 for heavy road transportation
- Co-located HRS with production plant (applying Fusion Fuel technology)

Madrid

Design Permitting Execution Operation

Description

- 60,000 kg of green H_2 per year
- Hydrogen dispensed at 99.999% purity and 350 bar
- Supplying 8 vehicles per day
- Vehicle refuelling takes c. 8 minutes
- Road cars and buses are being refuelled at the station

2021	2022-2023	2023
Model definition completed	Execution and construction	In operation

exolum utilising technology of FUSION-FUEL™

Tees Valley HYVE (Hydrogen Vehicle Ecosystem)

Deployment of a H_2 production facility and refuelling station (HRS) in Teesside, coordinated with the deployment of vehicles

Objectives

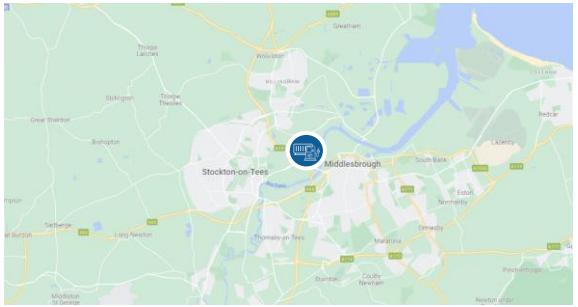
- Development of a hydrogen vehicle ecosystem, with HRS supplying a fleet of vehicles across the valley
- Achieve UK Government support for hydrogen mobility roll-out
- First UK HRS “Hub and Spoke” model deployment
  - Centralised green H_2 production at Exolum’s Riverside terminal (Hub) supplying an HRS (Spoke)
  - Allows for fast scaling of HRS infra

Tees Valley

Design Permitting Execution Operation

Description

- Centralised green H_2 production hub at Riverside
- H_2 refuelling station strategically located near Middlesborough town centre and major roads
- Deployment coordinated alongside 25 H_2 vehicles



Q4 2022 – Q3 2023	Q4 2023-Q2 2024	2024	2025
Grant process	Engineering design	Execution and construction	In operation

H_2 refuelling infrastructure

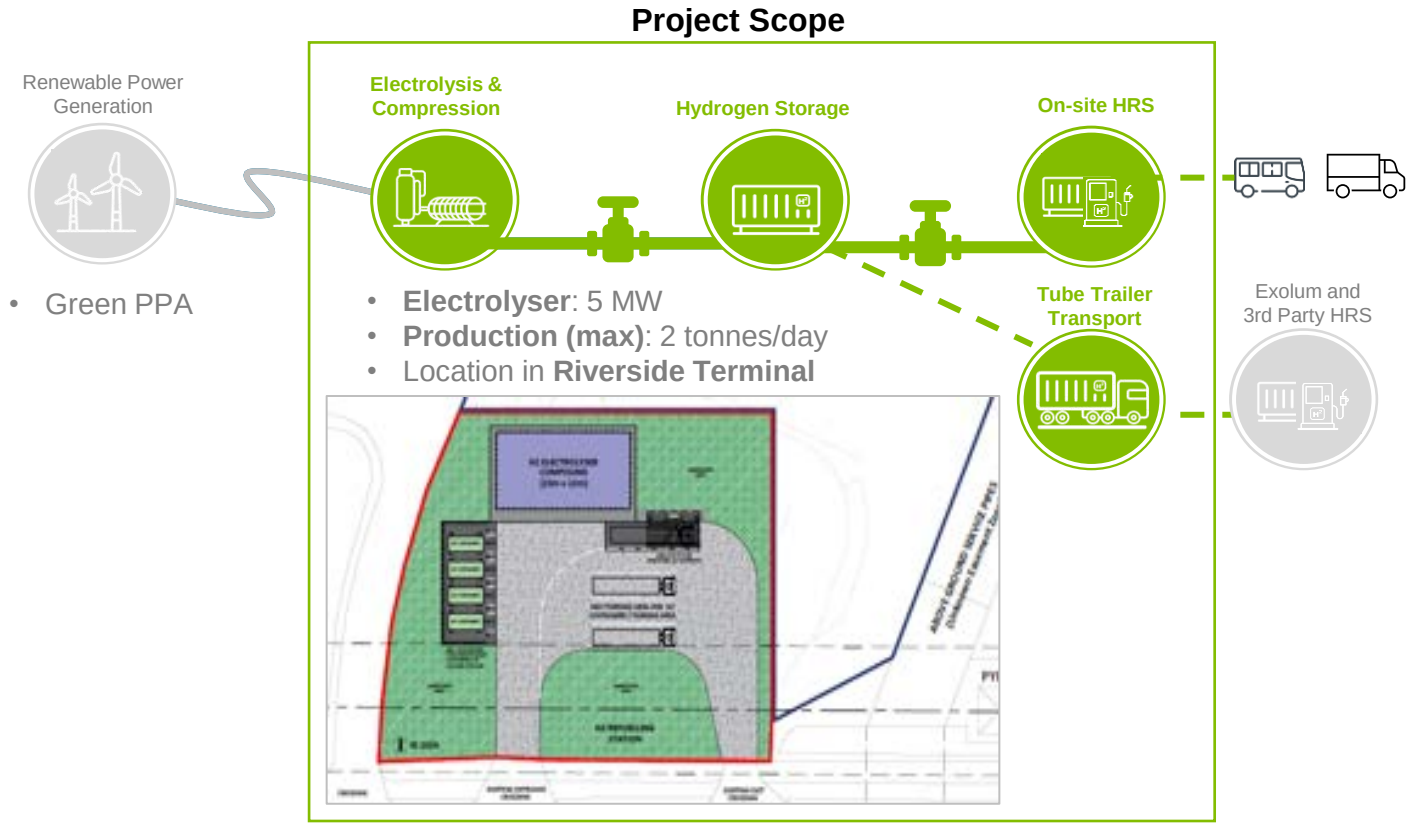
exolum

Project in collaboration with vehicle OEMs:

ELECTRA

Exolum's "Hub-and-Spoke" model delivers an end-to-end solution for H_2

Model allows for fast scaling of HRS infrastructure and supply security for offtakers



Exolum's project will secure significant benefits for hydrogen customers

Customers will progress with their environmental targets whist securing commercial and operational benefits

Customer Benefits

Zero CO2 Emissions
Exolum will produce green hydrogen using renewable electricity

Experienced Partner
Exolum has had success delivering and operating similar infrastructure in Spain

Central role in the hydrogen economy
This project will act as a catalyst for growth and jobs in the Tees Valley

Potential for National Expansion
Exolum is developing similar projects across the UK to build a national network of stations

Stable Price
Exolum will use a recognised price index over the length of the agreement, avoiding diesel volatility

End-to-End Solution
Exolum will be responsible for the hydrogen production and distribution, reducing counterparty risk

Long Term Supply Security
A long term supply agreement will ensure a secure supply of hydrogen over the course of a vehicle's life

Capacity for Growth
Exolum's facility will have the capacity to supply additional hydrogen vehicles as the market grows

John Winterbourne

Ballard

Novuna® Vehicle Solutions

Freight carbon zero

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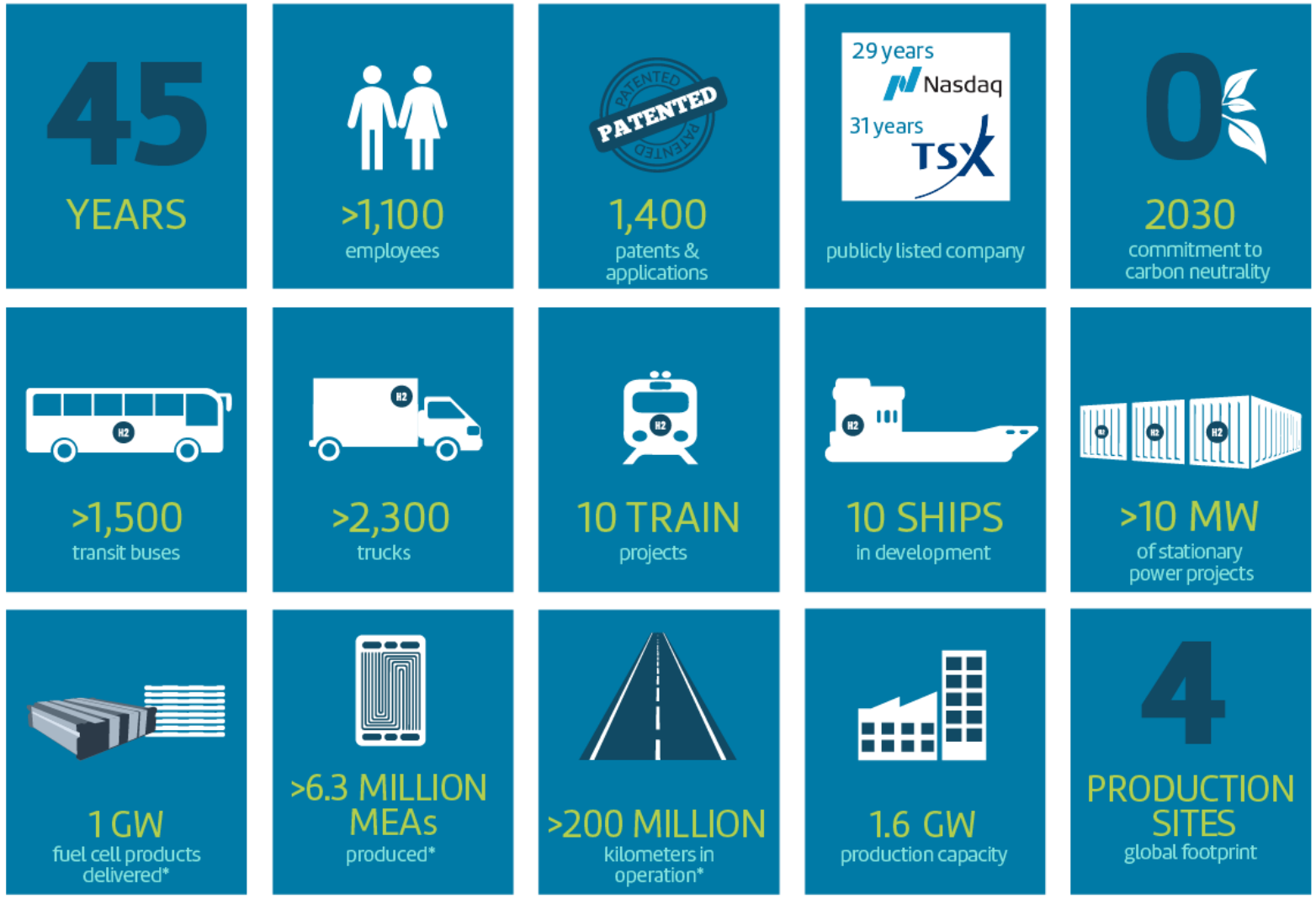
Fuel Cell Technology: Ballard's vision for zero emission trucks

2024

Ballard by the numbers



*compiled from 2015

The future of freight transport will be electric

- An electric powertrain is the efficient, quiet, zero-emission energy alternative to polluting diesel engines
- Electricity for the electric drive can be supplied from batteries or from an on-board fuel cell power generator or a combination of both – a hybrid architecture

BALLARD™

A hydrogen truck is an electric truck

Zero emissions

High efficiency

Electric Drive

Low Noise

Low initial infrastructure costs

Lower-cost maintenance

Higher powertrain efficiency

Low infrastructure costs at scale

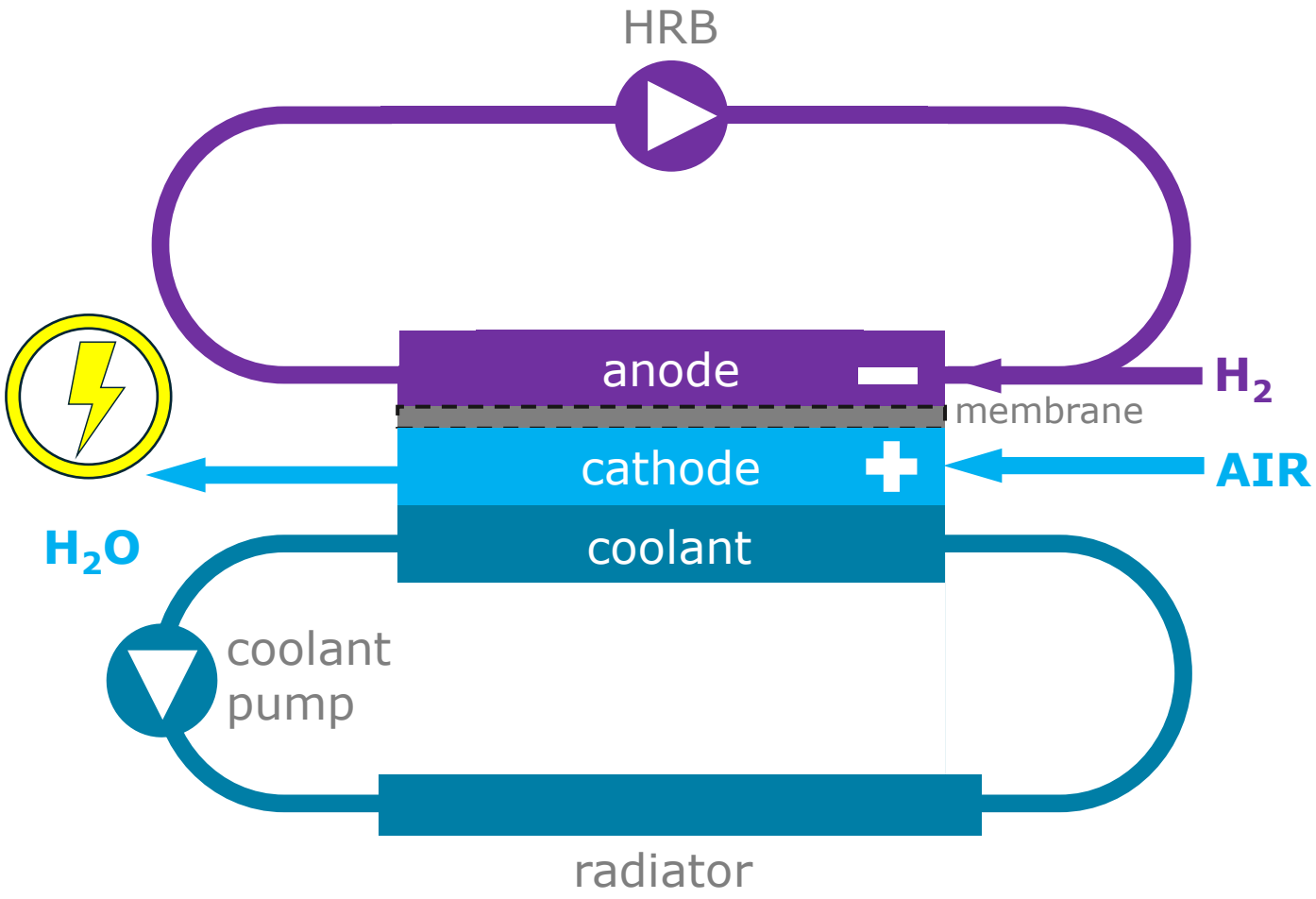
Fast refueling

Larger cargo capacity

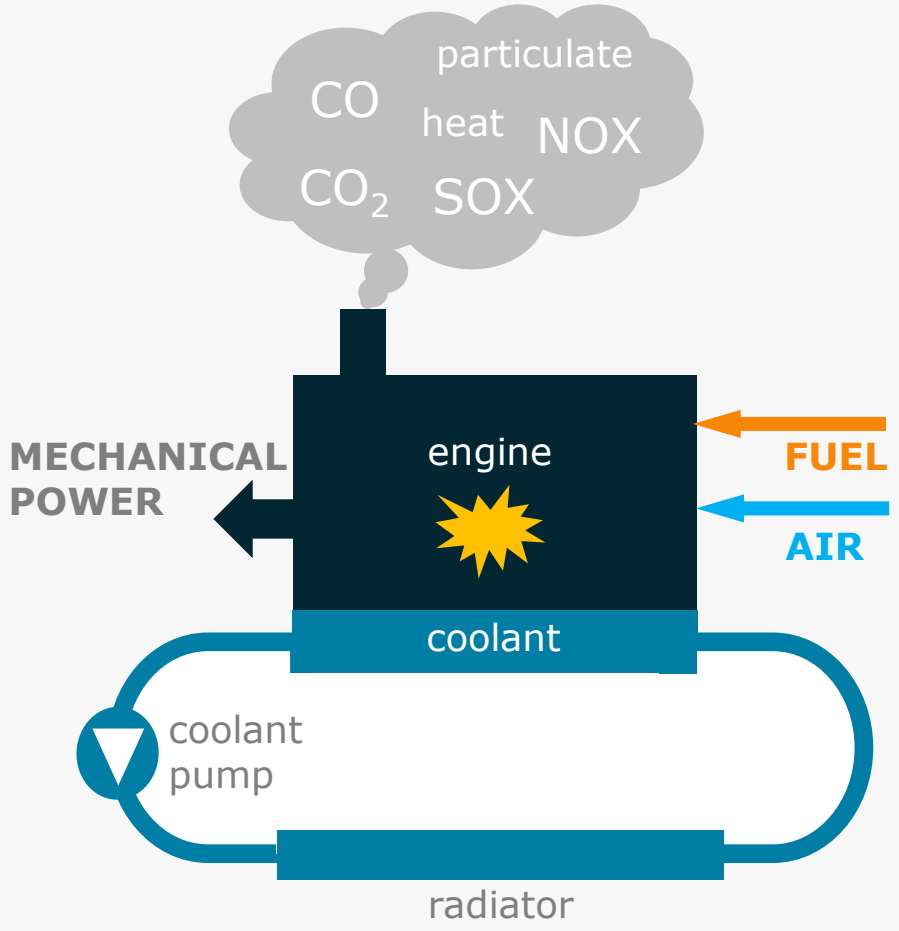
Long range

Extreme weather tolerance

How a fuel cell works



COMBUSTION TECHNOLOGY



Fuel cell systems powering multi-modal transport

Shipping

- 1.2MW fuel cell power demand
- FC-battery hybrid
- Payload 200 TEU

Rail

- 1.2MW+ fuel cell power demand
- FC-battery hybdrid

Road

- 240kW fuel cell power
- Up to 1500 km range
- FC-battery hybrid
- 19-65t truck

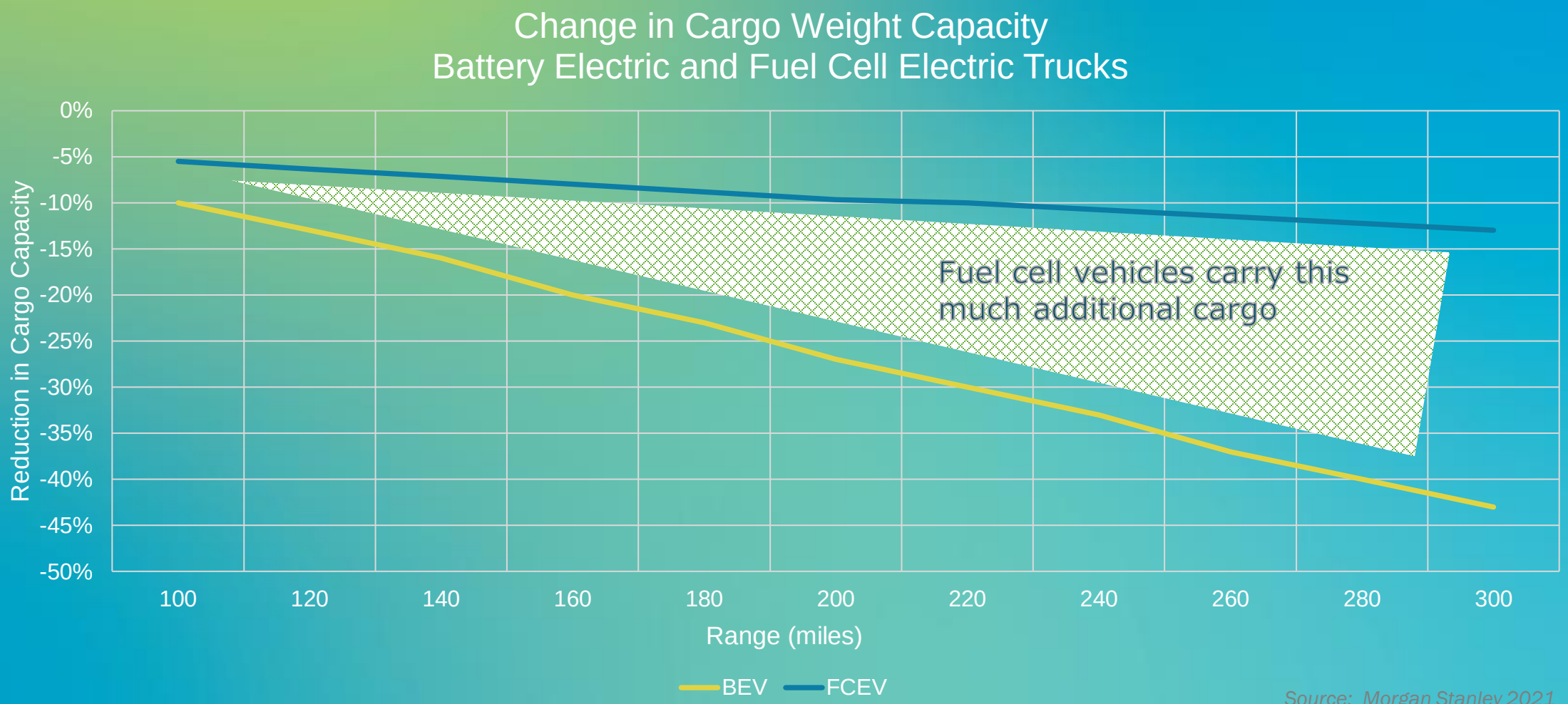
Warehousing

- Over 10 000 fuel cell stacks in operation
- Over 107 million hours run-time

Last mile

- 45kW fuel cell power demand
- 450 km / 15 min fueling
- 4.2-7.2t GVW

FCEVs offer a 30%+ cargo capacity advantage over battery electric vehicles at a 300 mile (480km) range



Source: Morgan Stanley 2021

Hydrogen safety

Risk Assessment of Hydrogen Fuel Cell Electric Vehicles in Tunnels (Equivalent to a ship)

Brian D. Ehrhart · Dusty M. Brooks · Alice B. Muna · Chris B. LaFleur

Photo 2 - Time 0 min, 3 seconds - Ignition of both fuels occur. Hydrogen flow rate 2100 SCFM. Gasoline flow rate 680 cc/min.

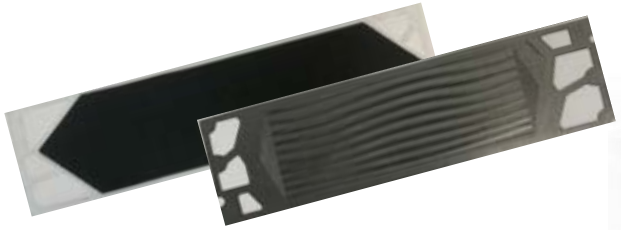
Photo 3 - Time: 1 min, 0 sec - Hydrogen flow is subsiding, view of gasoline vehicle begins to enlarge

Temp. Increase Inside Passenger Compartment is just 3° C

NO thermal runaways with Hydrogen

Ballard's business model

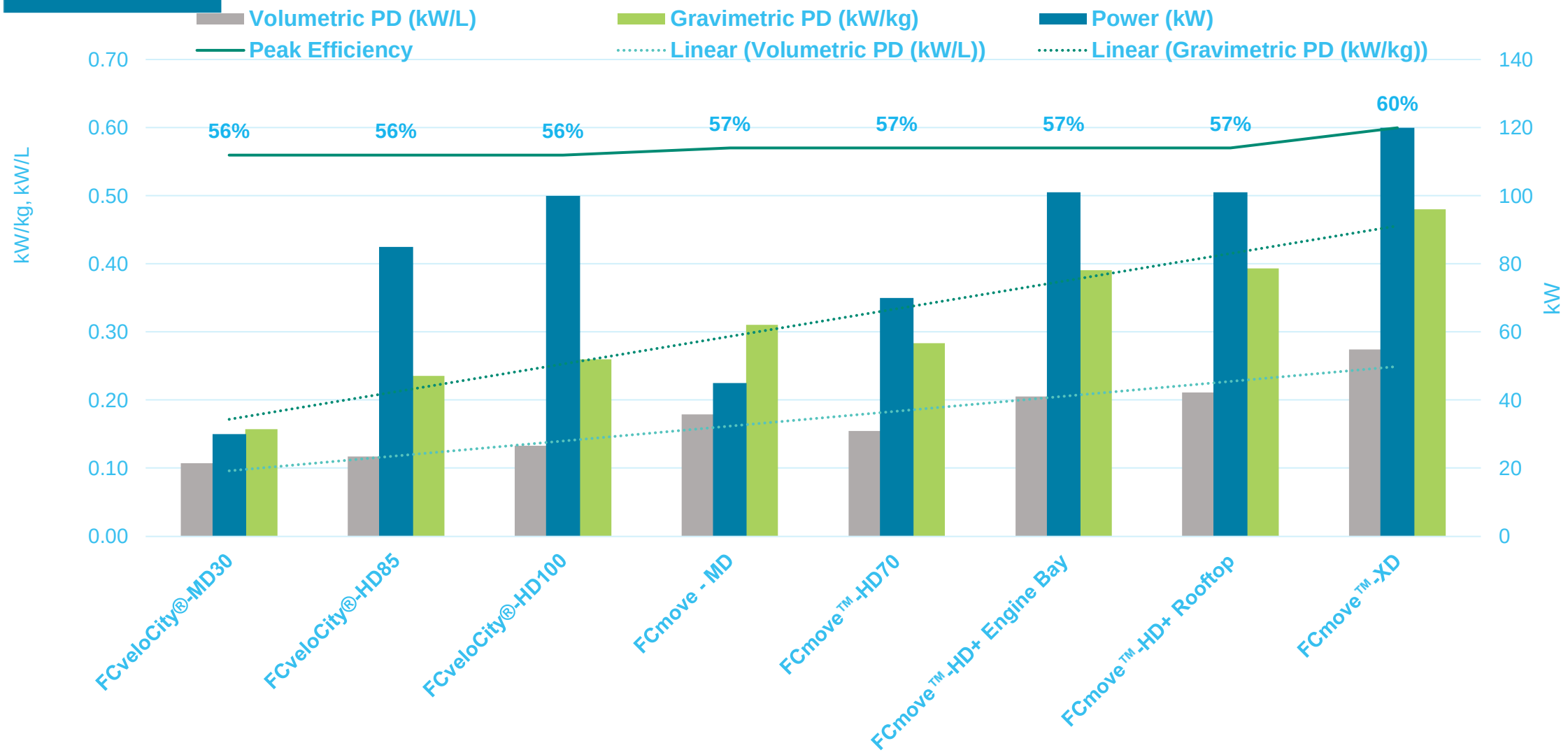
Fuel cell **MEAs, bipolar plates, stacks** & **modules**



Six medium & heavy-duty end application focus sectors:
bus, truck, rail, offroad, marine, stationary

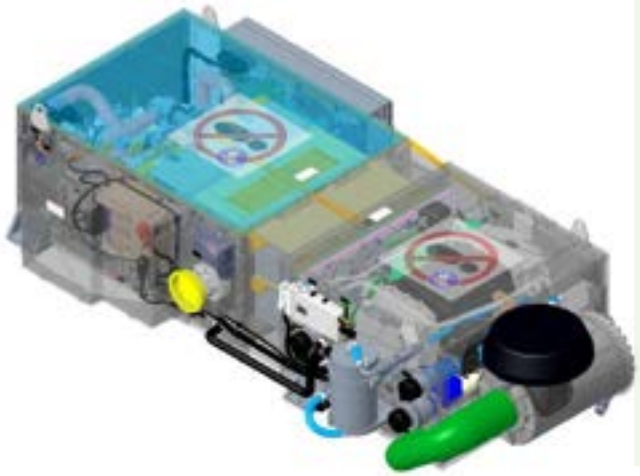
Primary markets in **Europe, North America & China**

Ballard Module Progression



Balance of Plant & Design Driven Cost Reduction

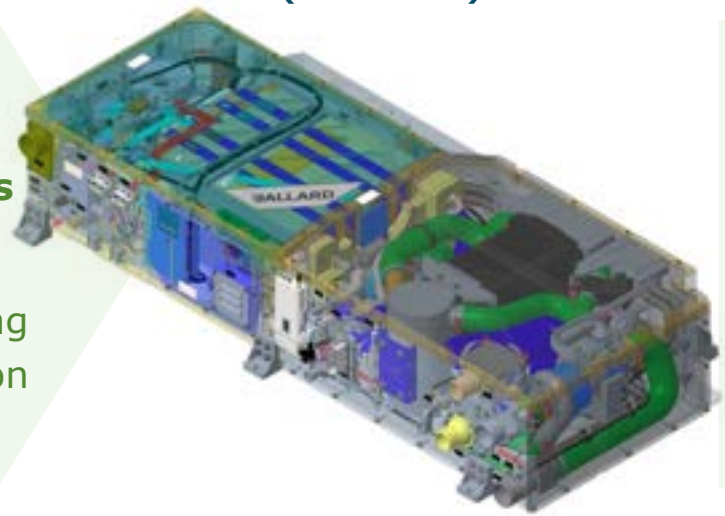
2019
FCmove-HD
(70kW)



~35% fewer parts

Significant manufacturing time reduction

2021
FCmove-HD+
(100kW)



~20% fewer parts

~50% assembly time reduction

2023
FCmove-XD
(120kW)

Driving down cost by **simplifying system design, reducing part count & joint supplier component development**

Our new solution for the MD & HD truck market

Ballard's new products will enable our partners to put fuel cell trucks on the roads by 2023

Ballard's FCmove-XD module is specifically designed for the medium and heavy duty commercial vehicles

- **120 kW fuel cell module with latest stack technology**
- Engine bay configuration
- Modular design (120kW - 240kW)
- **A product commercially available in 2024**

To ensure sustainability is considered over the entire lifecycle of our products

At Ballard we:

Design our product to minimize carbon footprint

Refurbish fuel cell stacks at the end of life

Re-use graphite bipolar plates

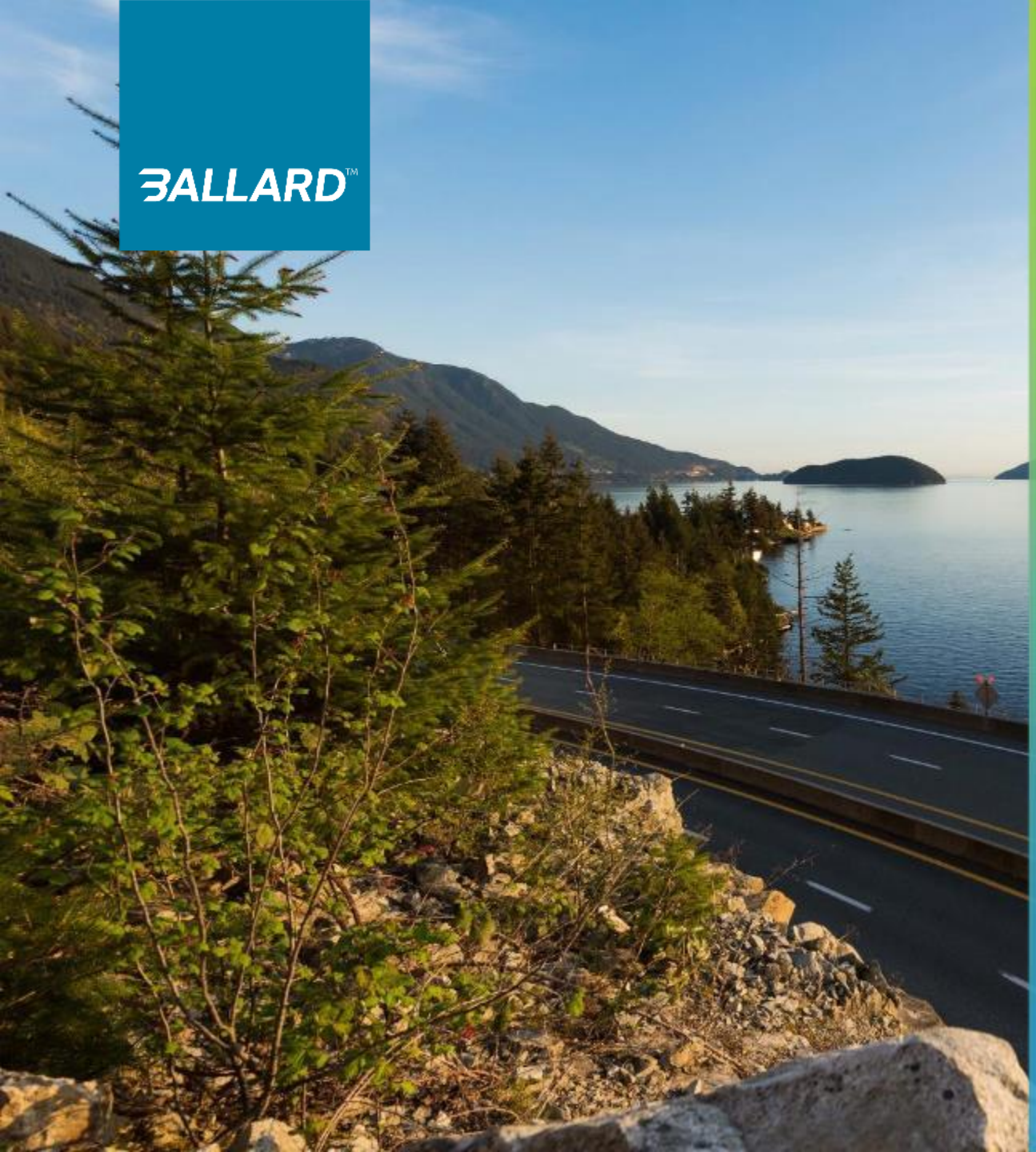
Reclaim 95% of the platinum

We are committed to be carbon neutral by 2030

>95%

Precious metals are reclaimed during recycling

Cost savings for the customers as a result of refurbishing



Here for life™

Thank you

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Ballard.com

Sharon van Beek

Quantron

Novuna® Vehicle Solutions

Freight carbon zero

MotorTransport

Sustainability becomes Reality
Zero Emission Solutions for a better Future

QUANTRON

Empower the Future

Corporate journey

40 YEARS HALLER DNA

Early customer success

Growth to 115+ employees

Launch USA Business

Delivery of first electric truck in KSA

Further global expansion continues

Construction of new HQ

Building strong brand identity

World premiers at IAA 2022

Successful A-Round

B-Round started

Use of funds
- Product scaling
- Gen 1.5 development
- PoC H_2 Infrastructure
- PoC Platform
- PoC QaaS Pilot Customers

Founded in 2019 — **2020/21** — **2022** — **2023** — **2024**

Product journey

Start as Retrofit

QLI BEV

QHB Refuse Collector

QLI FCEV

Retrofit to address untapped market demand

Pivot into OEM Light

QHM BEV

QHM FCEV

CIZARIS 12 EV

Class 8 FECV

QARGO 4EV

Own best-in-class vehicles pave our right-to-play

Transition into Platform

QaaS

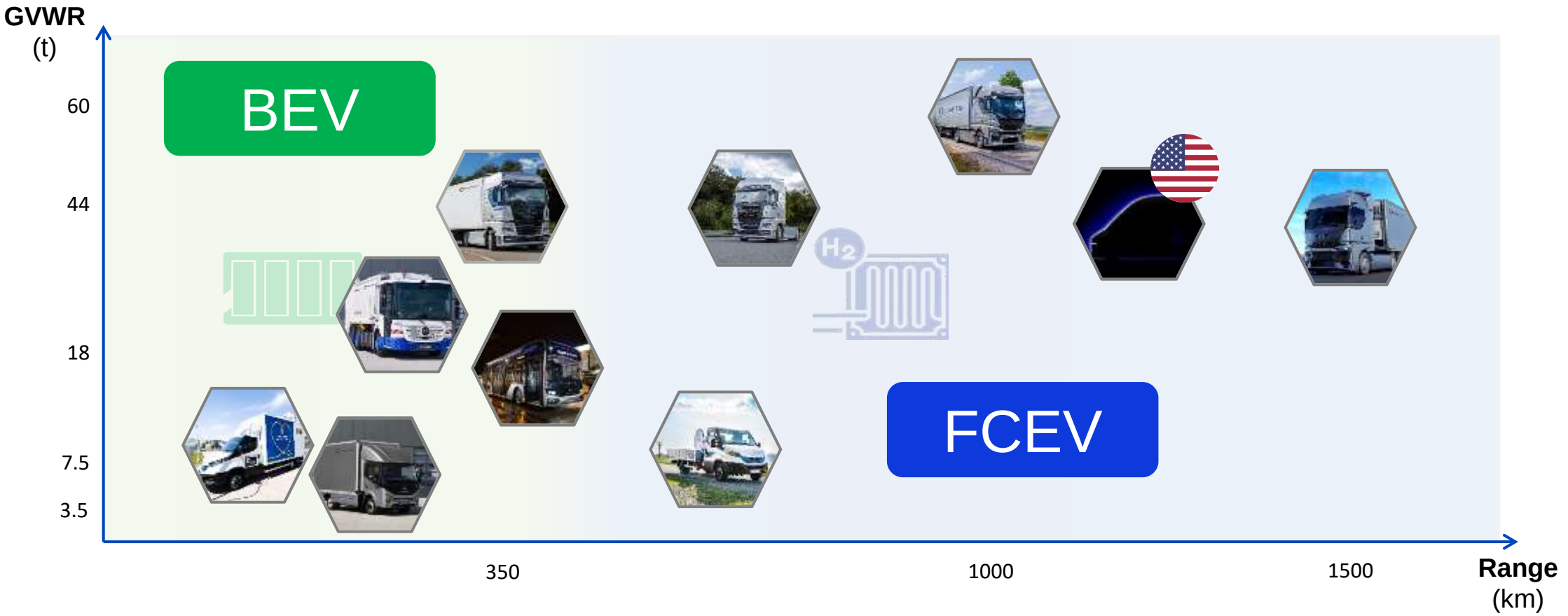
Platform as our right-to-win via ecosystem orchestration

Founded in 2019 — **2020/21** — **2022** — **2023** — **2024**

FCEV BEV

Empower the Future

QUANTRON BEV and FCEV solutions – both technologies fulfill major needs of sustainable transportation



QUANTRON

Product Portfolio

Empower the Future

Quantron Zero-Emission solutions:
Buses, transporters and trucks available on the road

CIZARIS

QARGO

QLI Bus


More to come...

QHM

QHB Waste-Collector

QLI

Ready to deliver ✓

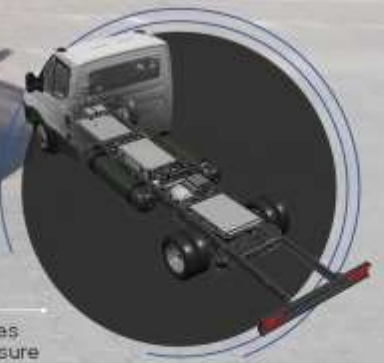
QUANTRON QLI FCEV

A versatile vehicle with a quiet and emission-free drive, ideal for various applications like logistics or inner-city deliveries, which can be tailored to your business requirements.

ZERO EMISSION - FULL H_2 POWER

Maximum efficiency

Thanks to its wide range of superstructures the Q-Light FCEV can be used flexibly in different areas of application, e. g. in the logistics industry or as a delivery vehicle.



Features

Zero Emission Range
up to 450 km*
BEV only mode for short distances for maximum efficiency

Fuel Cell
Powerful fuel cell with up to 45 kW

H_2 Tank volume
8,2 kg H_2

Refueling time
Short refueling times (similar to diesel)

*This is a preliminary simulated range.

Fuel Cell

- 45kW FCmove-MD fuel cell from the world's leading hydrogen expert Ballard Power Systems.

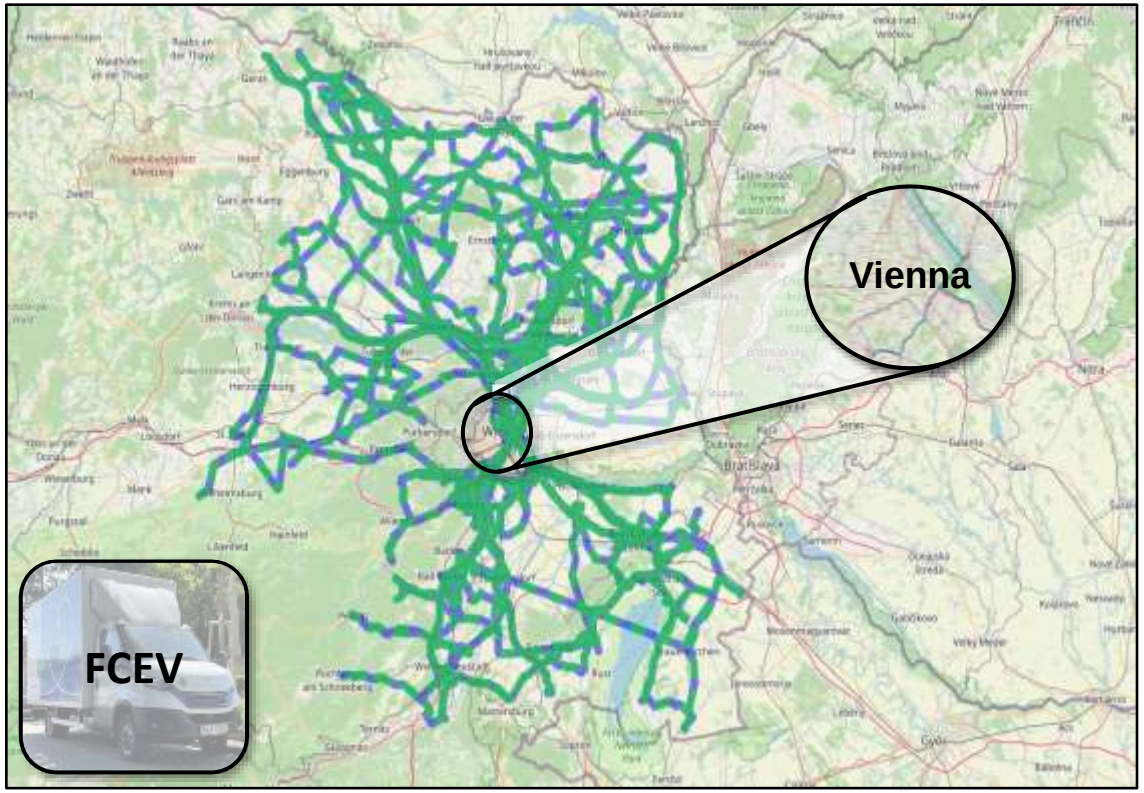
FCEV truck platform

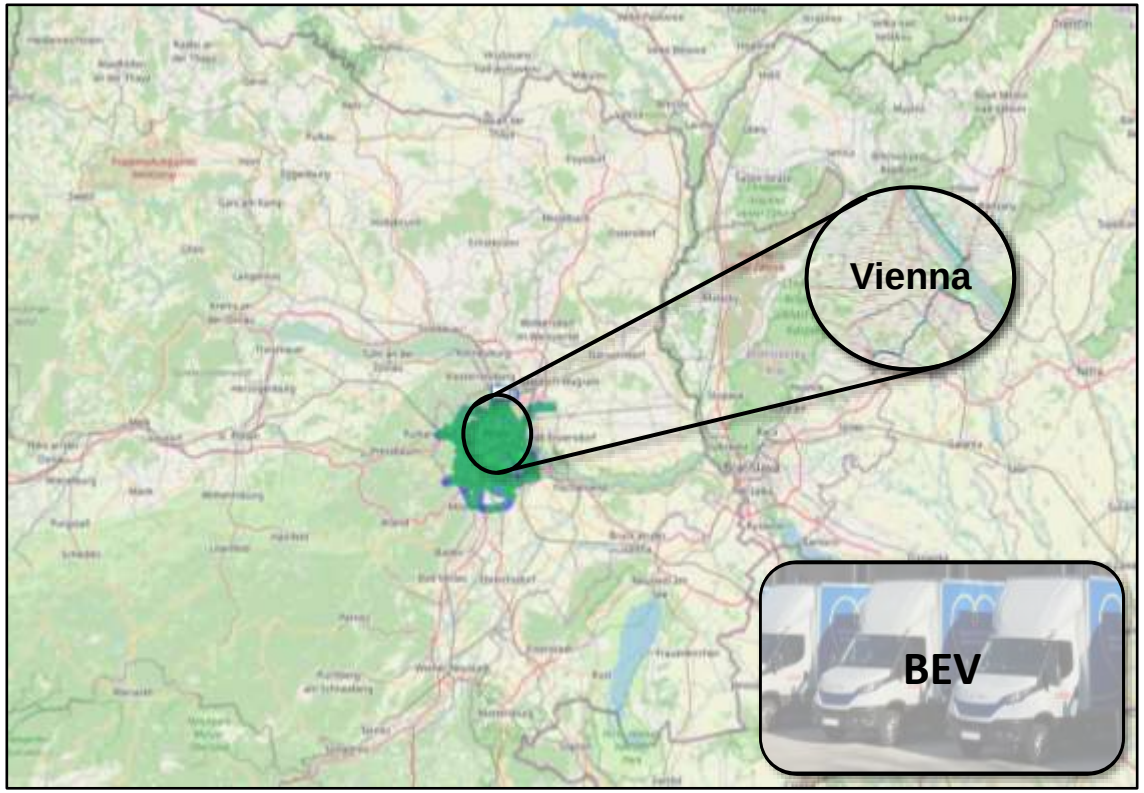
QLI with it´s unique „package" – utilizes renowned international partners to ensure high-quality equipment and safe technology are integrated in all its vehicles.

Empower the Future

QUANTRON

A direct comparison with reality in the LCV segment makes it clear why both technologies are necessary





IKEA FCEV Fleet Austria

Since Feb '24

Key Indicators:

5
Active Vehicles

22,585 km
Overall Mileage

97.6 %
Overall Vehicle Availability

9t
CO2 emissions avoided

ZERO EMISSION - FULL H_2 POWER

H_2 Range Champion

Maximum efficiency

Improved aerodynamics with the new design, reaching 20% drop in the drag coefficient, resulting 10% increase in the overall range!

Interior

Sustainability is not just about our zero emission vehicles, but also about our recycled textiles and sustainable materials used in the interior.

FCEV truck platform

QHM with it´s unique „package" – utilizes renowned international partners to ensure high-quality equipment and safe technology are integrated in all its vehicles.

QUANTRON INSIDE

Fuel Cell

240 kW (2 x 120 kW FCmoveTM-XD fuel cell) from the world's leading hydrogen expert Ballard Power Systems.

Features

- **Zero Emission range champion** 700 - 1500 km
- **ISO Trailer** compatible and standard length possible
- **H_2 Tank volume** 54 - 116 kg H_2 @700 bar
- **Axle config.** 4x2 tractor, 6x2 tractor, 4x2 chassis, 6x2 chassis
- **Refueling time** 15 minutes

QUANTRON

QUANTRON QHM FCEV AERO

Huda Dawood

Teesside University

Novuna® Vehicle Solutions

Freight carbon zero

MotorTransport

TEES VALLEY HYDROGEN VEHICLE ECOSYSTEM (HYVE)

DATA OVERVIEW

Dr Huda Dawood
Associate Professor in Research, Sustainability, and Energy Transition

Teesside University

OVERVIEW

01
Aim and Objectives

02
Approach

03
Performance Metrics

04
P Metrics Selections

05
Factors affecting PM

06
Data Analysis & Modelling

Teesside University

AIM

Evaluation of hydrogen fuel cell electric vehicles (FCEV) in a real-world setting

OBJECTIVES

01 Identify the current state and evolution of the technology

02 Identification and selection of the Critical Performance Metrics

03 Analysis of the selected Performance Metrics

04 Compare results to baseline

Approach

Data collection

Literature Review

Identify Performance metrics and performance metrics selections

Data exploratory analysis to explore the performance of the vehicle by measures and dimensions

Preliminary investigation of predictive models

PERFORMANCE METRICS

Deployment

Driving Behaviour

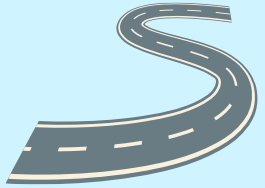
Durability

Fuel Cell Performance

Fuel Economy

Fuelling Behaviour

Hydrogen Performance



Range

Reliability

Teesside University

PERFORMANCE METRICS SELECTION

Range

Fuel cell Performance

Fuel Economy

Fuelling Behaviour

Hydrogen Performance

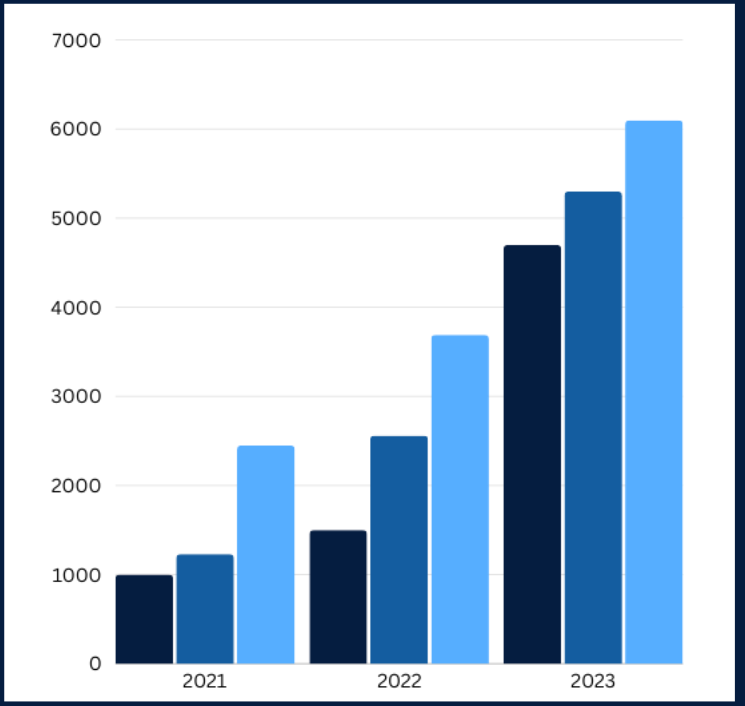
Teesside University

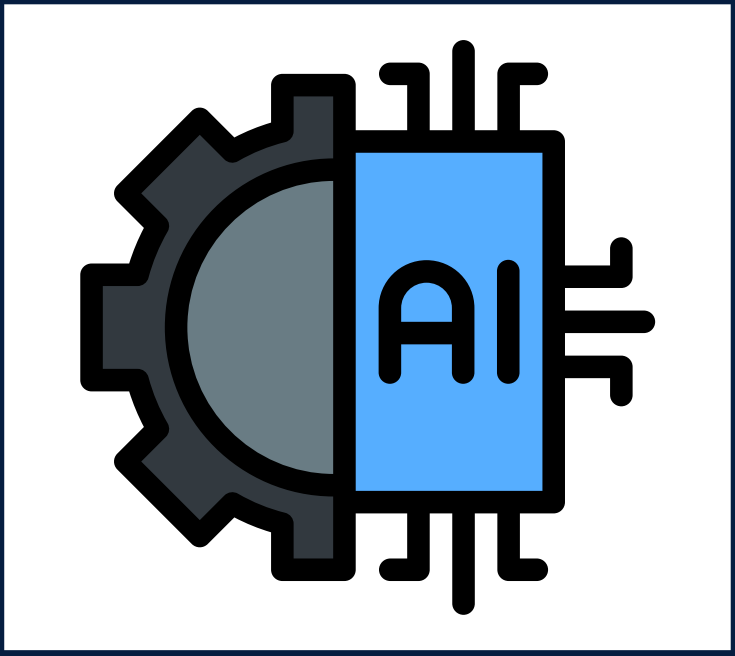
DEPENDENT FEATURES

- Day and time of measurements
- Driving distance associated with each vehicle
- Average speed
- Location of the Trip (GPS Coordinates)
- Temperature

Data Analysis & Modelling

- Employ statistical analysis techniques and modelling tools to process the collected data and develop predictive models
- Correlate variables with performance metrics.
- Train models using ML (e.g., neural networks, decision trees) to predict FCV performance based on input parameters.
- Validate the developed models by comparing their predictions with real-world FCV performance data.





Thank You

Any Questions?

H.Dawood@Tees.AC.UK

QUESTIONS

Novuna® Vehicle Solutions

Freight carbon zero

MotorTransport

THANKS FOR YOUR ATTENDANCE

To stay in touch with the decarbonisation of the road freight and commercial vehicle sector sign up to Freight Carbon Zero

Novuna® Vehicle Solutions

Freight carbon zero

MotorTransport