



Hydrogen Industry Leaders @ MIRA Tech Park

#TheFutureIsBuiltHere

© MIRA Tech Park. 2024



**Welcome to HORIBA MIRA and MIRA Tech Park
where our purpose is to improve lives ...**



Global-leader in engineering, research and product testing, and a strategic location for transport R&D



Vehicle Engineering Consultancy



Test Engineering Services



Technology Park

Our story

1946 - The Motor Industry Research Association formed

1948 - RAF Lindley chosen for research laboratory and proving ground

2012 - MIRA Tech Park awarded Enterprise Zone status

2015 - Acquired by HORIBA & business renamed to HORIBA MIRA

2023 - £63m of high value employment on-site with over 90% people living in Midlands

© MIRA Tech Park. 2024



Our cluster

Guiding industry through rapid change with single location for product development and verification

- 1 million sq. ft specialised R&D floorspace
 - 300k sq. ft under construction
- £500m+ vehicle engineering & testing facilities
 - Over 100km of proving ground test track
 - Euro NCAP accreditation
- 77 years of technical expertise
 - Development, integration, and verification

© MIRA Tech Park. 2024

TEVVA



Togg



VIRITECH



R3E



Polestar



HVS



Our campus



Enabling business growth:

\$22 billion venture capital raised by tenants since 2012

Talent development pipeline

Competitive path to Net Zero:

Virtual simulation and prototypes

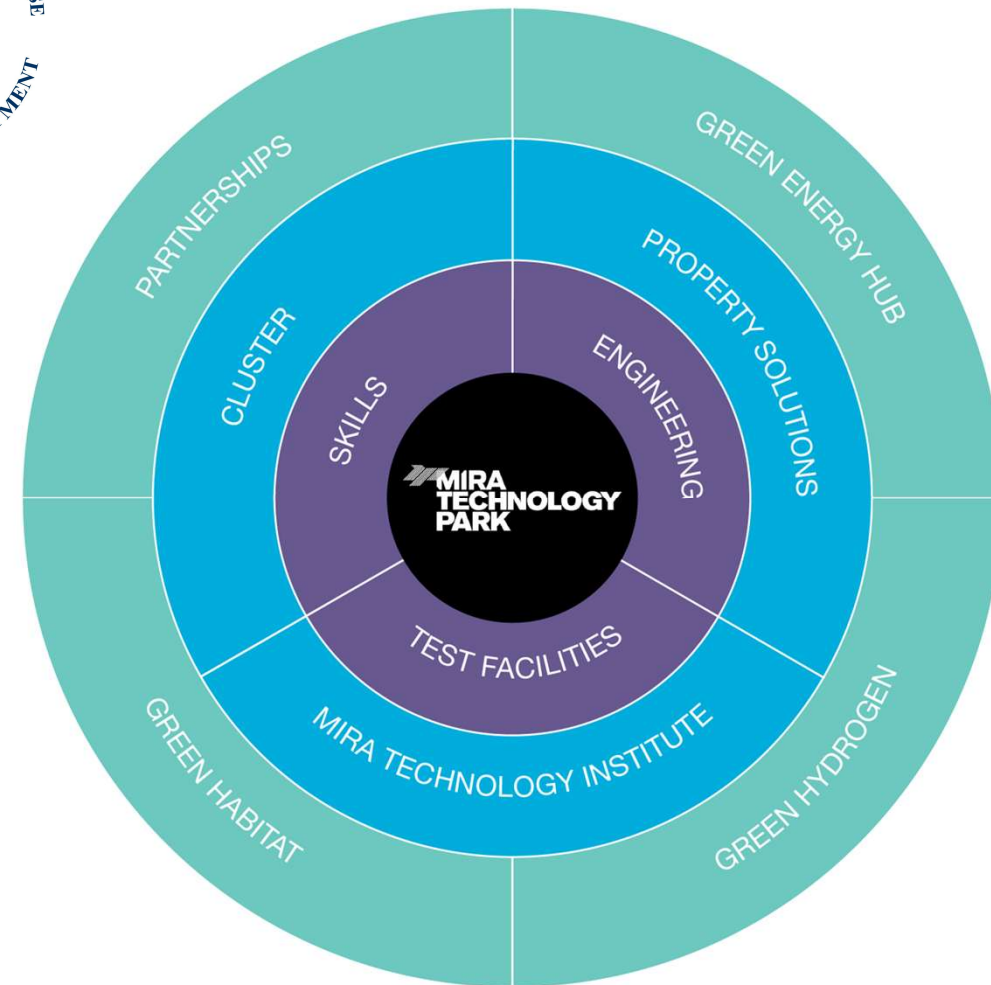
Sustainable location: energy, waste, water, wildlife

King's Award for Sustainable Development

Provide market opportunity:

Over £150m in Innovate UK projects

40 global tenants: corporate, spinout, high growth



£20m+ investment in hydrogen

'Hydrogen ready' vehicle development facilities:

- Climatic chambers
- Passive safety
- Thermal testing
- Electromagnetic compatibility

Green hydrogen infrastructure:

- 7MW solar array producing green hydrogen
- Hydrogen refuelling Hub (350 / 700bar)

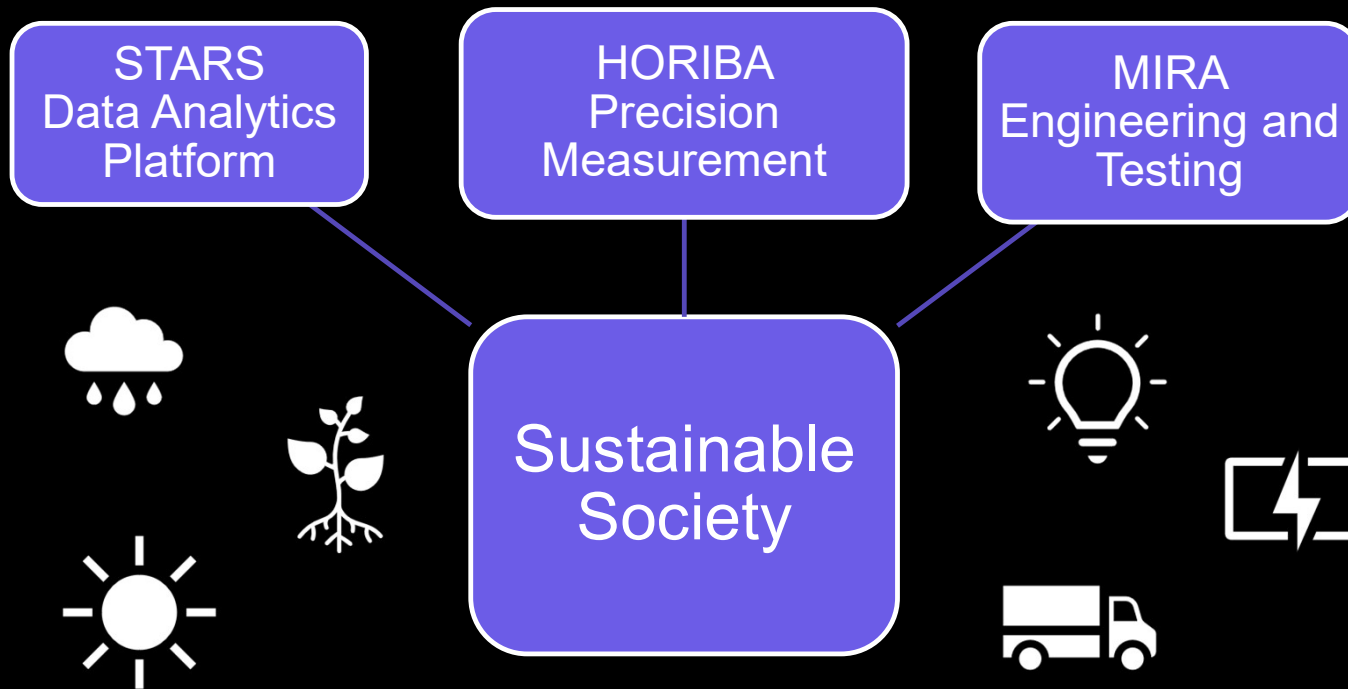
Specialised R&D workspace for hydrogen developers:

- Commercial vehicles
- Energy optimisation



One HORIBA Group

HORIBA



Our potential

Site potential 4 million sq. ft incubator to production

Expanding customer base:

Zero emission vehicle manufacturers

Enabling technology developers

Clean energy production

Supporting next generation of scale-ups:

Flexible property

Energy security

Decarbonised heat

New skills - technology and chemistry





Sarah Windrum

Future Mobility Cluster - Lead

E: Sarah.Windrum@horiba-mira.com

T: +44 2476 355000

MIRA Tech Park

Watling Street, Nuneaton, Warwickshire, CV10 0TU, United Kingdom

www.miratechnologypark.com

© MIRA Tech Park. 2024





MIRA Technology Institute

Lisa Bingley Operations Director

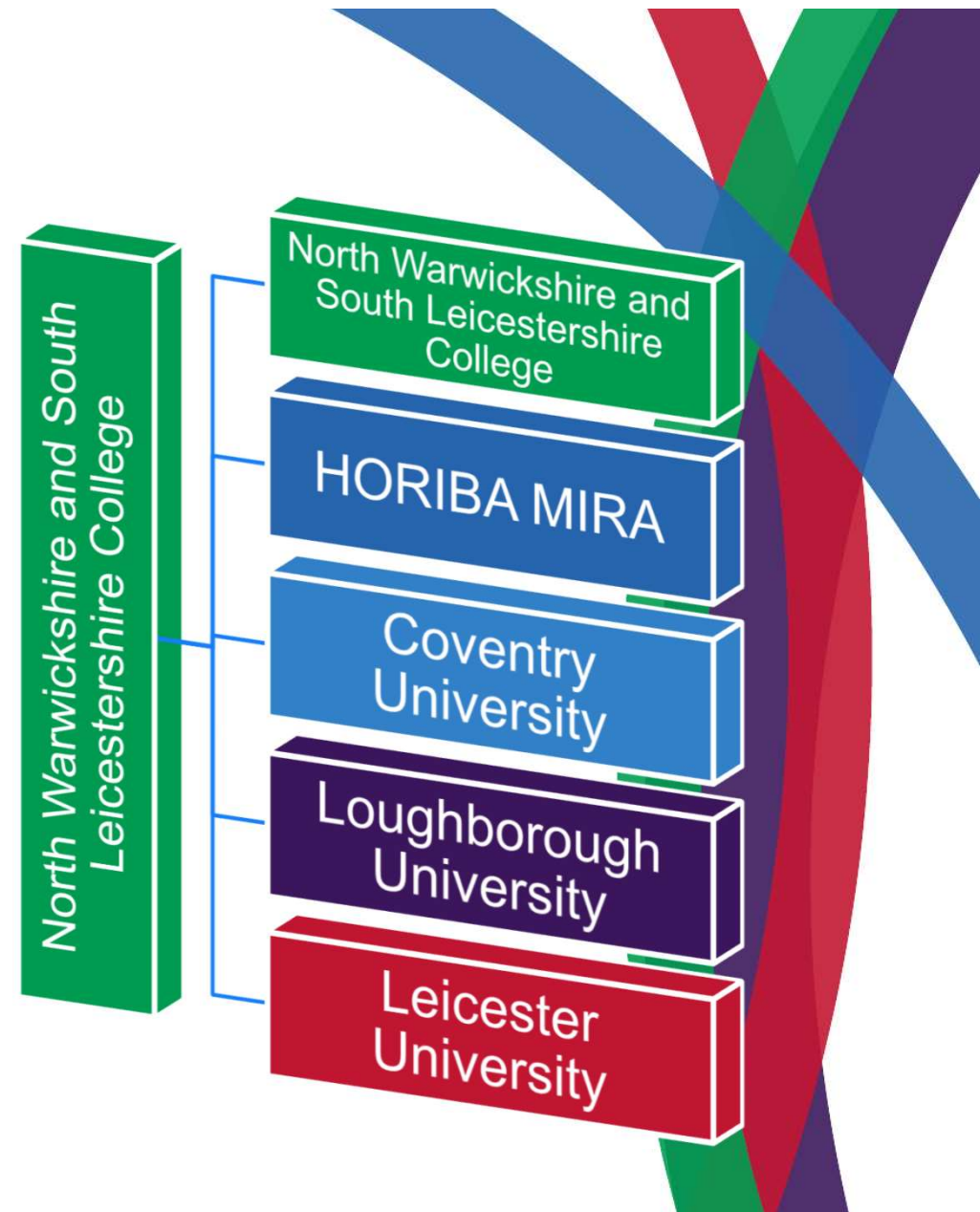


Welcome to the MTI



What is the MTI?

- Unique collaboration between North Warwickshire and South Leicestershire College, and our partners, HORIBA MIRA, the University of Leicester, Loughborough University and Coventry University.
- Built with investment from the UK Government's Growth Fund via the LLEP, it's a specialist facility to train the next generation of Transport and Energy Engineers
- We provide specialist skills training in some of the emerging technology areas including electrification and driverless cars, ensuring a sustainable supply of future technical specialists and engineers.



Why do we need the MTI?

- The automotive and transport sector faces an electric future
- Autonomous, connected, electric and shared vehicle technology
- Electrification, cyber security and the latest emissions technology.
- Coventry is a hub for Connected Autonomous Vehicle development
- Technology role-out threatens to outstrip the pace of skills development

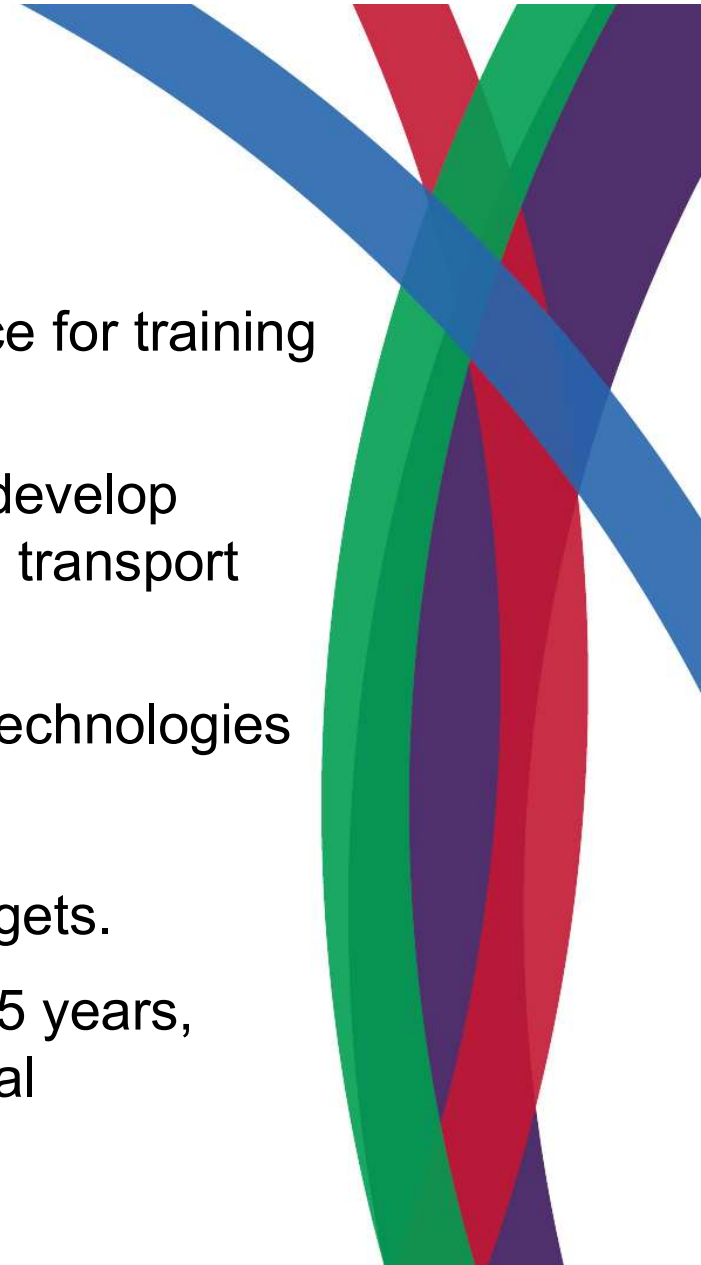


Our Mission and Vision

- To be the national and international centre of excellence for training in the automotive sector and beyond
- Working in partnership with industry and education to develop critical skills to support the development of sustainable transport infrastructures
- To create bespoke and relevant training for emerging technologies

All contributing to the achievement of net carbon zero targets.

- We have welcomed 50,000 students and delegates in 5 years, over 18,000 of those being professionals in professional development activities.

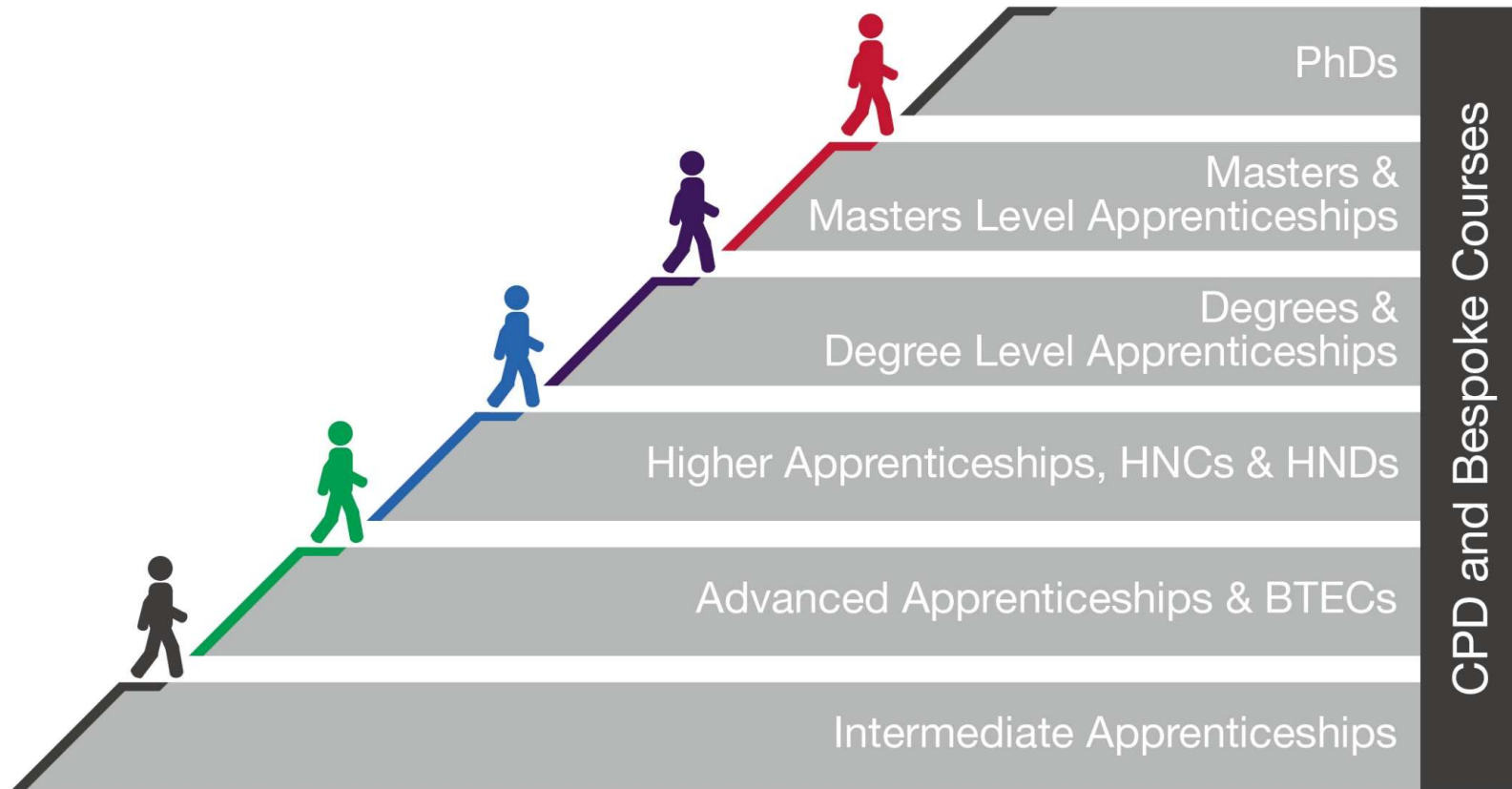




Curriculum



Skills Escalator



Importantly we are employer led – it's essential we work with YOU

© MIRA Tech Park, 2024



Founding Partners



Technical engineering apprenticeships
Levels 1 – 4 and Electric Vehicle courses

Delivering short **technical and non-technical training courses** using industry specialists and using the on-site test facilities

Bringing **Masters Level Connected Vehicle** courses and **Automotive Degree Apprenticeships** at Level 6+ and commercial industry updating

Offering short modules on automotive **Postgraduate Certificates – links to the Hydrogen IOT**

Focusing on **Continuous Professional Development modules**

What do we offer?

CPD Short Courses

Vehicle Safety and Security

- ISO 26262 Engineer Contents
- Introduction to Cybersecurity
- SOTIF – Safety of the Intended Functionality - Principles and Practice
- ISO26262 Safety Analysis Techniques
- Functional Safety / ISO 26262 Awareness Course
- ISO 26262 Process Auditing
- Independent Safety Assessment
- Automotive Safety Case Development

Electric and Hybrid Vehicles

- IMI Electric and Hybrid Vehicle Awareness
- IMI Electric and Hybrid Vehicle System Repair and Replacement
- L4 Award in the Diagnosis, Testing and Repair of Electric/Hybrid Vehicles and Components
- Advanced Hybrid Electric Vehicle Awareness
- xEV Control Systems Architecture
- Basic Hybrid and Electric Vehicle Safety Awareness
- Battery System and Technologies
- Basic and Advanced Hybrid Electric Vehicle Awareness
- Electromobility Awareness
- EV Thermal Awareness
- General EV Architecture Awareness

Automotive Engineering

- IMI Air Conditioning Accreditation
- IMI Pre MOT Tester
- IMI CPD MOT Tester
- IMI CPD MOT Manager
- Introduction to Vehicle Dynamics
- Measurement Uncertainty

Business and Leadership

- Essentials Engineering Project Management
- Lean Six Sigma
- Lego Serious Play
- Manual Handling
- Fire Marshal

Emissions

- Hydrogen Fuel Cells and Their Applications

Apprenticeships, Under-graduate Post-graduate Courses



Level 2

- Autocare Technician
- Engineering Operative (Maintenance)

Level 3

- Engineering Technician (Product Design and Development Technician)
- Engineering Technician (Technical Support Technician)
- Motor Vehicle Service and Maintenance Technician

Level 4

- HNC General Engineering
- Propulsion Technician
- Engineering Manufacturing Technician

Level 6

- BEng (Hons) Automotive Engineering
- MEng (Hons) Automotive Engineering
- Product Design and Development Engineer Degree Apprenticeship
- Manufacturing Engineering Degree Apprenticeship

Level 7

- Postgraduate Certificate Intelligent Vehicle Systems
- MSc in Connected and Autonomous Vehicle Systems
- Postgraduate Engineer: Product Design and Development Apprenticeship

Hydrogen Courses

- The Impact of Hydrogen HGV to the World of Logistics and Automotive Level 3 (3 days) due Q4
- Understanding Hydrogen HGV – Awareness and Behaviours Level 1 (1 day) due Q2
- Hydrogen Fuel Cells and their Applications (1 day) available
- IMI Hydrogen Vehicle Awareness Level 1 (1 day) available
- New Toyota MIRAI Rig and training rigs to demonstrate on



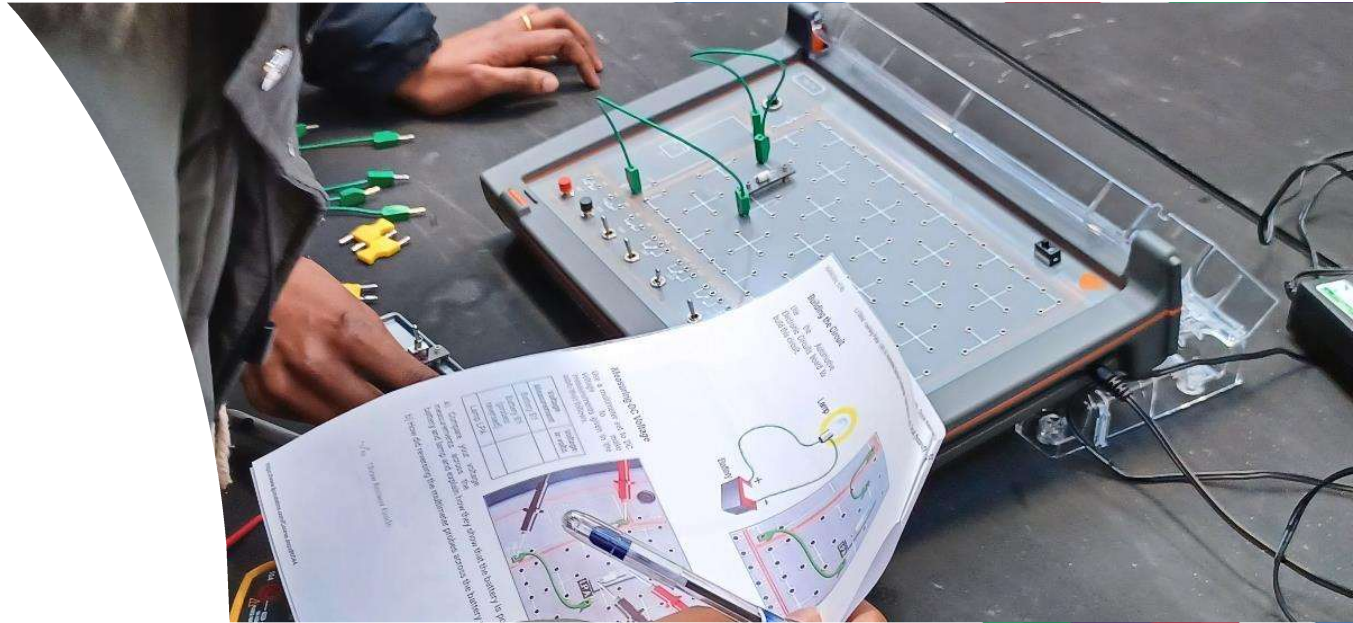
Electric Vehicle Courses

- Level 1 IMI Electric and Hybrid Vehicle Awareness
- Level 2/3 IMI Electric and Hybrid Vehicle System Repair and Replacement
- Level 4 IMI Award in the Diagnosis, Testing and Repair of Electric/Hybrid Vehicles and Components
- IMI Hybrid Basic and Advanced Electric Vehicle Awareness
- EV Thermal Awareness
- Electromobility Awareness
- Battery System and Technologies



Case study - JLR

- Bespoke course created by both education and industry partners
- Practical course to convert mechanical engineers to electrical engineers
- Over 600 delegates on the fundamentals course to date





The Facility



World Class Facility

- Classrooms
- Workshops
- Public working space
- Canteen - costa
- Conference room 100+
- Hospitality
- Charge points

Tour of the facility

© MIRA Tech Park. 2024



Achievements



Working with all local authorities



Welcomed 50,000 students and delegates in 5 years



Over 15,000 delegates have taken part in professional development activities



100% success rate with our learners on our EV courses



Active STEM work with schools, councils and employers. Over 2000 Students visited the MTI



Supported Internships since 2021



Winners of the Innovation in Education and Training Award at Leicestershire Live 2019



East Midlands Chamber Education and Business Partnership Award 2019 Finalist and 2021 Winner

Why choose MTI?

Unique collaboration between industry and education to deliver essential skills for the global automotive sector and beyond

Developing specialist skills in key areas of emerging technology

Augmented training, utilising industry expertise and the world class HORIBA MIRA facilities

Broad curriculum and flexible delivery to meet the needs of employers and their staff

Located within Europe's leading automotive technology cluster at MIRA Technology Park, right at the heart of the UK Auto Industry



The future of skills development

- No quick fix to the skills gap developing talent takes time. MTI students will have access to emerging technology, that's sector specific training at all levels
- Single collaborative organisation
- Transforming skills locally, regionally and globally – particularly at high levels locally regionally and globally
- **MTI represents the future of technical training - but it relies on the support of all employers to take advantage of our offer**



Thank you – Any Questions?

Lisa Bingley

BEg (Hons) CEg MIMechE

Operations Director

T 024 7693 5686

E lisa.bingley@mti.ac.uk

miratechnologyinstitute.co.uk



mti.ac.uk

enquiries@mti.ac.uk



MTI_Tweets



MIRA Technology Insitute





Project ICE Breaker

Host: Simon Dunnett

Technical Sales Manager - Net Zero & Vehicle Propulsion



Who am I?



Simon Dunnett CMgr CMI

Technical Sales Manager - Net Zero & Vehicle Propulsion

Over 25-years of electrified powertrain engineering experience

Who are we?



Vehicle Engineering
Consultancy

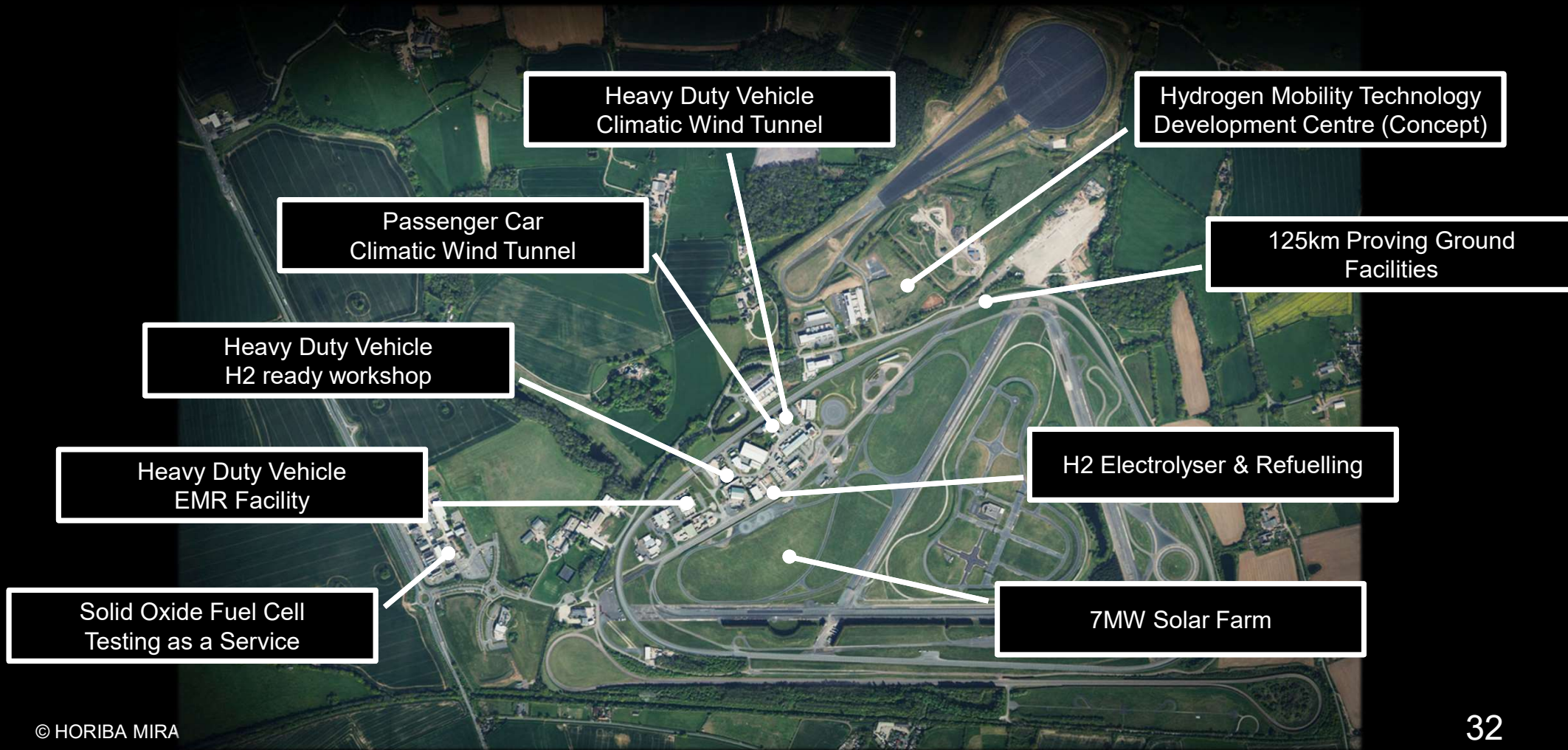


Test Engineering
Services

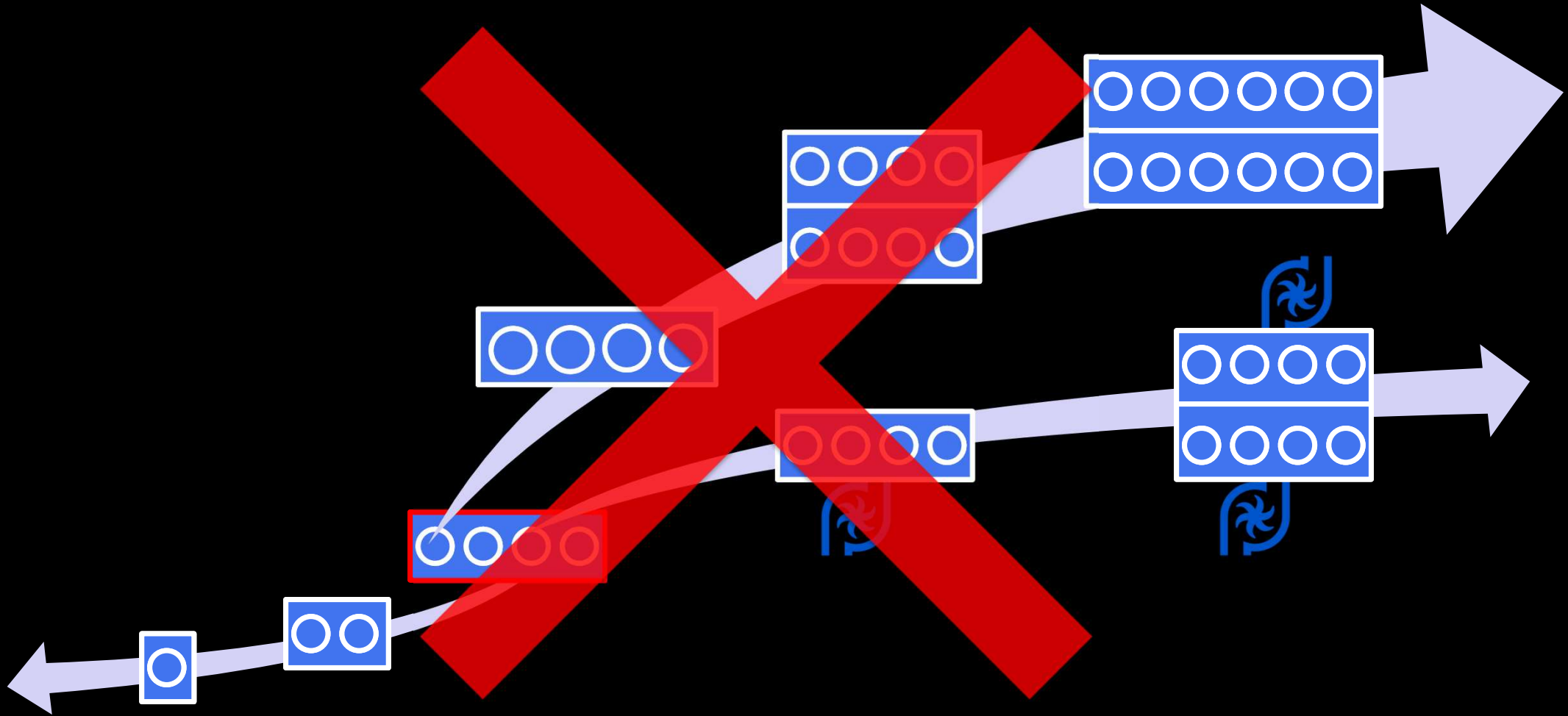


Technology
Park

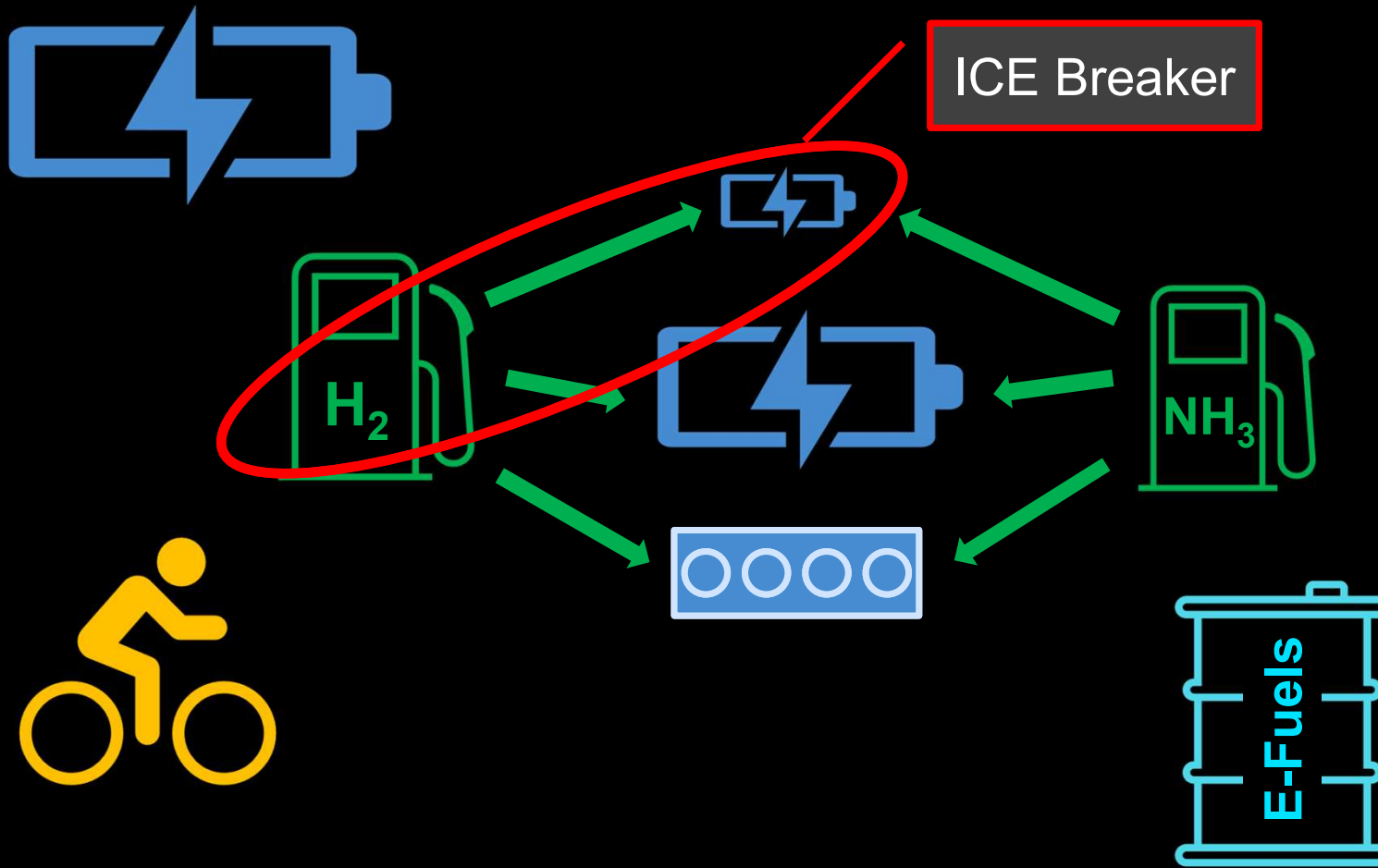
Hydrogen at HORIBA MIRA



Problem: 100-year Powertrain History



So, what's the solution?



Introduction



Collaborative project between Viritech, HORIBA
MIRA and Intelligent Energy

APC Funding to develop a 44T Hydrogen Fuel Cell
Demonstrator



Tri-volt technology

Hydrogen Storage and
Handling



Vehicle Engineering

System Integration

Digital Twin Technology



Fuel Cell technology supply

Project Aims – HORIBA MIRA



- ➔ Demonstrate our vehicle engineering, integration and test engineering prowess
- ➔ Create a test platform for further engineering development
- ➔ Adaption of our vehicle control software for fuel cell applications
- ➔ Showcase the vehicle at the Cenex Expo 2024 (Early September)
- ➔ Development of a correlated Fuel cell powertrain digital twin to complement our existing HEV and BEV digital twins
- ➔ Add a correlated Fuel cell powertrain digital twin into our Total Cost Optimisation (TCO) tool chain

Outline Vehicle Specification

16 kWh Battery System

28kg H2 Storage (700 Bar)

Predicted Range 270 km

Two Intelligent Energy DRIVE HD100 Fuel cells



Project Content

Vehicle Benchmarking



Project Lead



Exploitation



Fuel Cell System



Digital Twin



High Voltage System



Vehicle Commissioning



Thermal System



Vehicle Controller



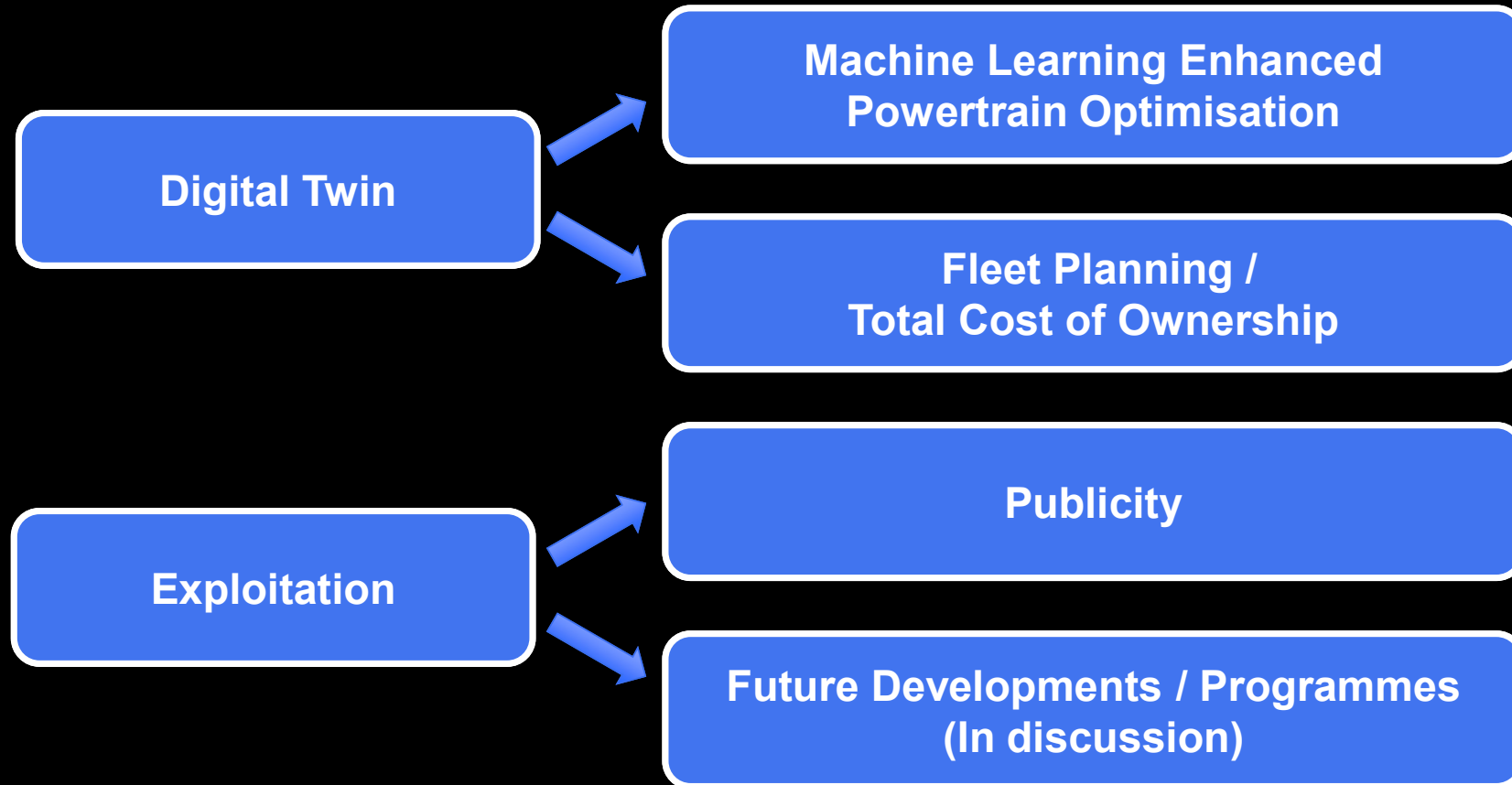
Vehicle Integration



Vehicle Build



Next Stage



Project Outcomes



Demonstrate our vehicle engineering, integration and test engineering prowess



Create a test platform for further engineering development



Adaption of our vehicle control software for fuel cell applications



Showcase the vehicle at the Cenex Expo 2024 (Early September)



Development of a correlated Fuel cell powertrain digital twin to complement our existing HEV and BEV digital twins



Add a correlated fuel cell powertrain model into our Total Cost Optimisation (TCO) tool chain

Questions?



Simon Dunnett

CMgr FCI

Technical Sales Manager
Net Zero Solutions & Vehicle Propulsion

M: +44 (0)7702 510538
E: simon.dunnett@horiba-mira.com

HORIBA MIRA Ltd.
Watling Street,
Nuneaton, Warwickshire,
CV10 0TU, UK

T: +44 (0)24 7635 5000
F: +44 (0)24 7635 8000

www.horiba-mira.com

Transforming industry for a sustainable world

MTC overview with hydrogen focus

For HIL Meeting

September 2024

© MTC 2024 | The data contained in this document contains proprietary information. It may not be copied or communicated to a third party, or used for any purpose other than that for which it was supplied, without prior written consent from MTC.

mtc  where
progress
happens

About us

- + Opened in 2011
- + Independent RTO
- + To bridge the valley of death
- + Prove innovative ideas
- + Manufacturing system solutions
- + £120+ million turnover
- + 900+ members of staff incl. 450 engineers
- + 90+ industrial members
- + Part of the HVM Catapult Network
- + Innovate UK

Our founders:

UNIVERSITY OF
BIRMINGHAM

 Loughborough
University

 The University of
Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

How MTC is helping Net Zero technologies develop



Supercritical Solutions



WHO MTC IS HELPING

HOW MTC IS HELPING

1 Wider understanding of sector and common industrial challenges and **creating communities** to solve problems

2 Delivering **Innovative Technical Solutions** and introducing solutions from different sectors

3 Delivering **Transformational Change:**

- ▶ Business
- ▶ Technology Transformation
- ▶ Supply chain

Create a **significant positive impact** on society by enabling product-based business to generate **zero carbon** economic growth and people to develop technical skills and knowledge.

TECHNICAL SOLUTIONS

- ▶ Additive Manufacturing
- ▶ Non-conventional machines
- ▶ High integrity fabrication
- ▶ Intelligent automation
- ▶ Design and simulation
- ▶ Manufacturing informatics
- ▶ Metrology and NDT
- ▶ Electronics manufacturing
- ▶ Tooling and fixturing

How MTC can help (at any stage or as a development)

DISCOVERY



Design for X

Component and product Design
Physics Modelling
Design for Additive
Automated Design

PROCESS DEVELOPMENT AND QUALITY

Technology Down-selection
Additive Manufacturing
Laser Processing
Automation and Robotics
Electronics Manufacturing

EQUIPMENT DESIGN

Special Purpose Machines
Robotic Workstations
End Effectors and Fixtures
Bespoke Machine Builds

FACTORY DESIGN

Scenario Mapping
Layout Optioneering
Discreet Event Simulation
Virtual Build Event
Visualisation

SKILLS AND WORKFORCE DEVELOPMENT

Future Skills Foresighting
National Apprentice Standards Creation
Upskilling and Reskilling
Training and Apprenticeship Delivery

SUPPLY CHAIN DEVELOPMENT

Assessment and Oversight of Supply Chain
Targeted Supplier Development Programme

DIGITAL ADOPTION

Simulation and Modelling

Digital Enterprise Down-selection

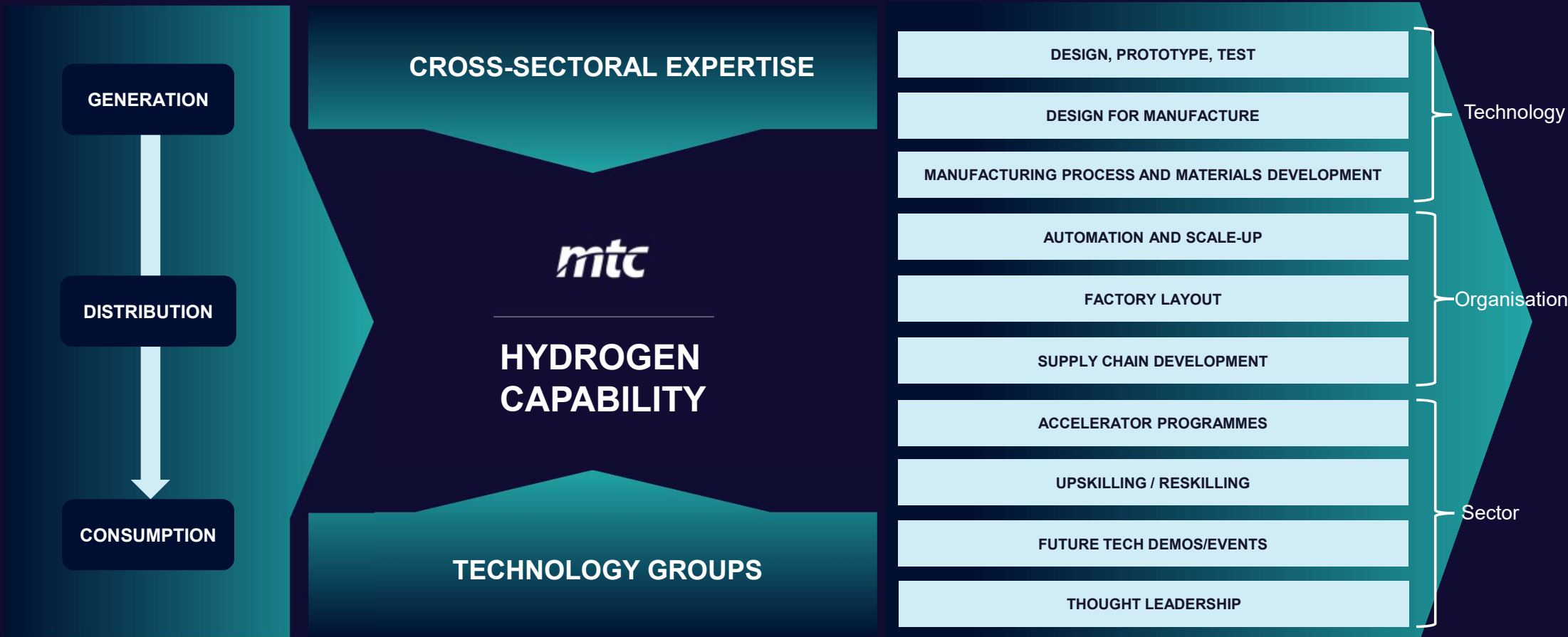
Digital Twins

AI and Machine Learning

IIoT

Predictive Analytics

Hydrogen support activities

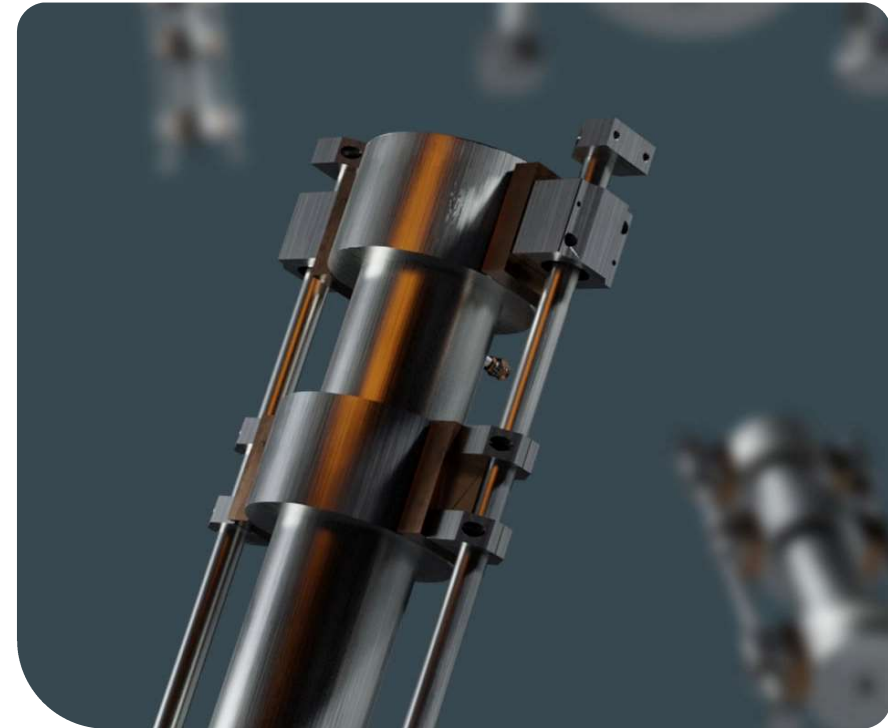


Project WhiskHy – Supercritical electrolyser

MANUFACTURING PROCESS AND
MATERIALS DEVELOPMENT

Supercritical has solved the biggest inherent problem of membraneless electrolyzers, gas separation, achieving over **99% purity** in both the oxygen and hydrogen outlets, with the system running at as low as **42 kWh/kg of H₂** and delivering **220 bar of pressurised gases**, without gas compressors

- 220 bar high pressure separated oxygen and hydrogen
- >50% emission reduction vs PEM
- Planet first - no iridium, no PFAS (forever) chemicals
- <€2 /kg of hydrogen, this decade
- Use case is whisky distilling



 **SUPERCritical**

mtc where
progress
happens

SUNTORY
GLOBAL SPIRITS

Project WhiskHy - demonstrator

MTC is supporting the manufacture of elements of the plant utilising advanced manufacturing laser processing



Project Shylo

- ▶ **CONSORTIUM** led by H2GO awarded £4.3m by the UK former department for Business, Energy & Industrial Strategy (BEIS now DESNZ)
- ▶ **GREEN HYDROGEN** produced by wind and tidal power stored in H2GO's proprietary hydrogen system and fed into the local system
- ▶ **SAFER** and lower cost alternative to compressed hydrogen stored as a metal hydride
- ▶ **H2GO's** HyAI software will optimise and manage the hydrogen hub
- ▶ **PROJECT COMMENCED** in February 2022 with build just



- ▶ Project funded under Hydrogen Supply 2
- ▶ Investigating the opportunity for metal organic frameworks (MOFs) as a technology for hydrogen storage for a use case within transport solutions
- ▶ Specifically MOFs utilised in conjunction with cryogenic processes have potential to create a volumetric advantage over pressurised gas by a factor of over 10x
- ▶ The vehicle system will require new storage methodologies and new on-board processes – one of these will be the storage tank
- ▶ MTC is supporting the collaboration on the design and build of this new pressure vessel to hold the MOFs for the on-board H2 storage
- ▶ The use case demonstrator is aiming at a medium sized HGV e.g. equivalent size to a rubbish cart

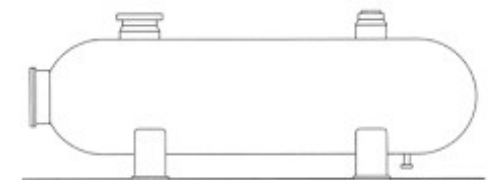
Metal-organic frameworks (MOFs)



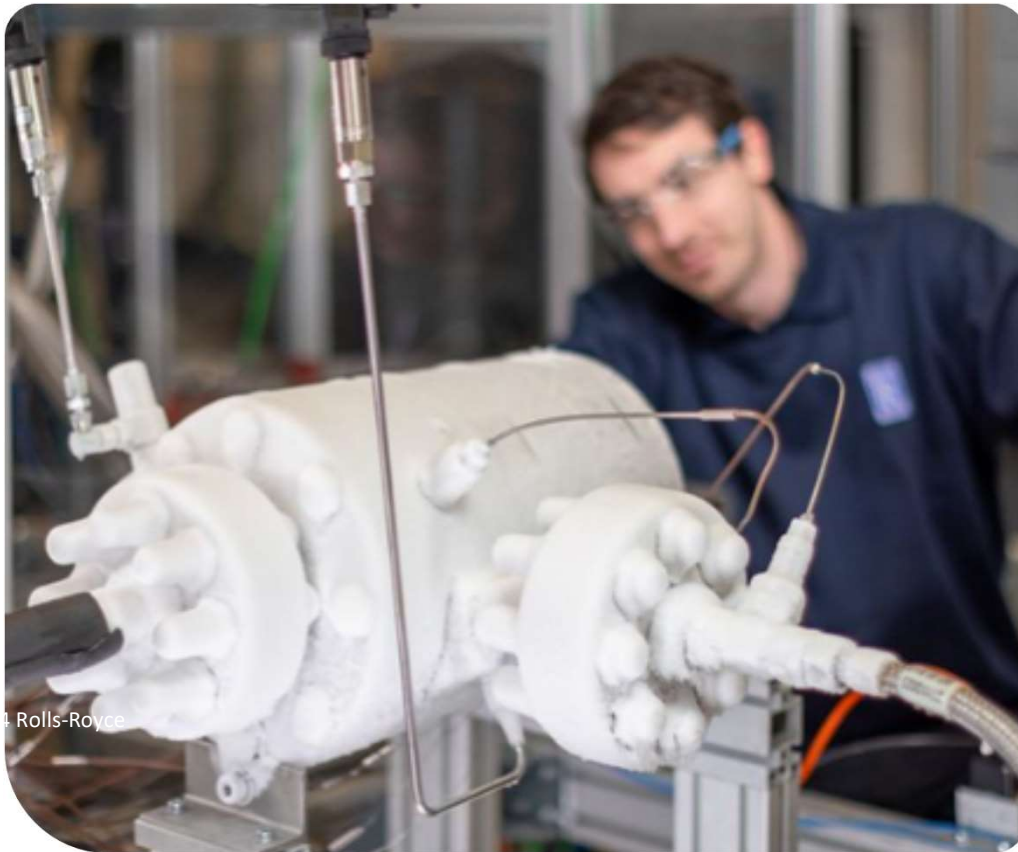
Metal-organic frameworks (MOFs) are synthesised from **metal clusters** and **organic linkers**.

They form regular lattices with significant pore volumes, giving them the largest surface areas of any material.

MOFs are highly tunable and can be designed to allow molecules to be **selectively adsorbed** onto this surface.



Rolls-Royce liquid hydrogen gas turbines



ATI Funded £31.4m programme through to September 2025

A consortium led by Rolls-Royce, including Cranfield University, easyJet, Heathrow Airport, MTC, Reaction Engines, UCL and University of Oxford to develop gas-turbine control system technologies that will enable aircraft engines to operate on liquid hydrogen.

The programme and wider work is covering technologies to control and transport the fuel from the aircraft's liquid hydrogen fuel tank to the engine combustor, including cryogenic pumping, fuel metering, system thermal management, intelligent control systems and component life optimisation.

Here we can see initial tests taking place, focused on pressurizing low-pressure liquid Nitrogen to understand behaviour at cryogenic conditions.

Feasibility of hydrogen HGV fleet for HS2

Assessing the hydrogen HGV supply chain for HS2

- ▶ **HS2** through the HS2 innovation programme is investigating the use of hydrogen as an alternative fuel for HGVs for construction, starting with a dual-fuel system.
- ▶ **MTC** has supported this by mapping the hydrogen landscape and supply chain and developing a strategic business case for the use of hydrogen in HGVs, considering both risks and benefits of entering into an emerging market.
- ▶ **FUNDED** by HS2
- ▶ [Hydrogen HGVS In Construction \(the-mtc.org\)](https://the-mtc.org)



Optimisation of metallic porous structures

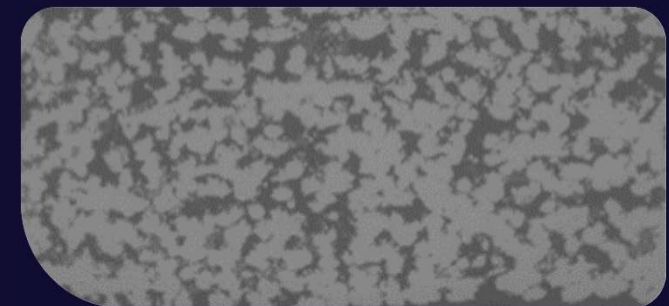
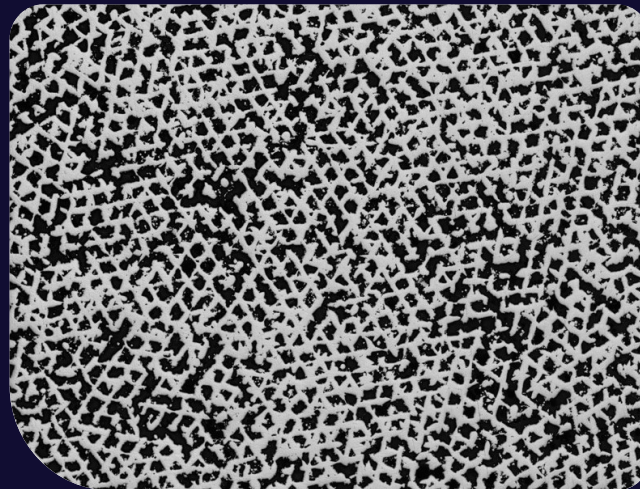
MANUFACTURING PROCESS AND
MATERIALS DEVELOPMENT

Drivers

- ▶ **THE TAILORING** of porous structures (including graded features) is becoming of greater interest in thermal management and gas separation technologies
- ▶ **APPLICATIONS** include filtration systems, heat exchanges and porous transport layers (electrolysers and fuel cells)

Demonstrator project

- ▶ **CREATION** of material demonstrators showcasing MTC's capability to manufacture porous structures
- ▶ **FOCUS** on metals
- ▶ **INVESTIGATION** using field-assisted sintering technology, additive manufacturing and laser drilling

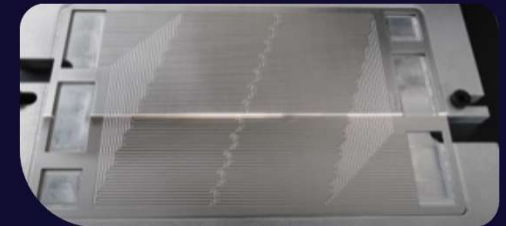


Laser technology - metallic bipolar plates

MANUFACTURING PROCESS AND
MATERIALS DEVELOPMENT

Application of laser technology

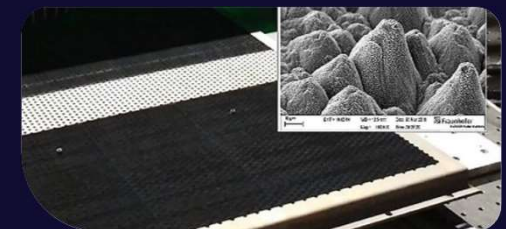
- ▶ Laser texturing of the bipolar plates to improve adhesion to thermal coating/e-coating
- ▶ Laser cleaning of the plates to remove oxides, oils, that would otherwise interfere the good adhesion of coatings and improve the fuel cell efficiency
- ▶ High-speed laser welding of bi-polar plates
- ▶ Laser structuring to help increasing the efficiency of conventional water electrolysis processes



Laser cleaning of the bipolar plates



Laser welding bipolar plates



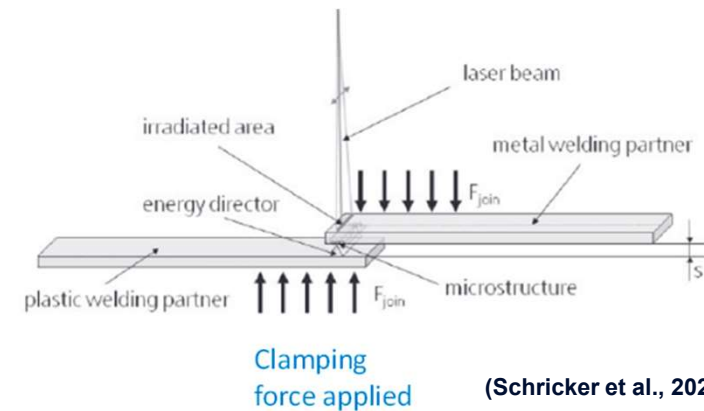
Laser structuring of electrolysis

Dissimilar-material joining

MANUFACTURING PROCESS AND MATERIALS DEVELOPMENT

Drivers

- ▶ **THE JOINING** of dissimilar materials requires development in many applications for enhanced sealing and joint integrity, and tailored heat and electrical conductivity
- ▶ **APPLICATIONS** include fusion, type-IV hydrogen tank storage and electrical powertrains



Demonstrator project

- ▶ **CREATION** of two demonstrators showcasing MTC's capability to join dissimilar materials
- ▶ **POLYMER-METAL** adhesive free joining
- ▶ **COLLABORATING** with the National Composites Centre (NCC) on applications





Our **mission** is to accelerate critical technologies and supply chains in the UK for the fast-growing global hydrogen economy.

HII is working with >200 companies and 10 sector bodies in the UK, to coordinate innovation in 9 critical technology areas across:



Hydrogen Production



Hydrogen Distribution



Hydrogen Use

HII is working with industry to drive innovation and supply chain development, working across UK industry and with support from our Industrial Advisory Board: bp, Airbus, Cummins, GKN Aerospace, H2Go, Hydrogen Energy Association, Hydrogen UK, Johnson Matthey, National Gas, ZeroAvia

HII is generating **technology roadmaps**, forecasting **sector demand** and **markets**, and mapping **UK capability**.

HII partners:



Supported by
Innovate UK



The UK Hydrogen Innovation Opportunity and supporting reports



The UK Hydrogen Innovation Opportunity





Thank you & look forward
to future collaboration

