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NORTH EAST BATTERY ALLIANCE

North East Battery Alliance Launch Event

Day 2 - Wednesday 11th May

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BRITISHVOLT

Advance Northumberland

CONNECTED ENERGY

THE FARADAY INSTITUTION

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Day 2

Wednesday
12th May 2022

09:30

Welcome

09:50

Part 1 - The landscape, main drivers, public and private perspectives

11:45

Panel Session

13:15

Part 2 – The Challenges – Themed Interactive Sessions (focusing on highlighting the key challenges and how to develop

In parallel from 13:30

Investment suite and focus group in the Catalyst Boardroom – Inward & Capital Investment

16:05

Networking

NEBA

Colin Herron

FINE

Ryan Maughan

EV North

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Brian Walker

PVC
Newcastle University

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Jamie Driscoll

Elected Mayor
North of Tyne Combined Authority

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NORTH EAST BATTERY ALLIANCE

An Overview of NEBA

PRESENTED BY

Prof Colin Herron
Position

University of Sunderland · Durham University · Newcastle University · North East Local Enterprise Partnership · The Faraday Institution · Teesside University · cpi · Northumbria University Newcastle

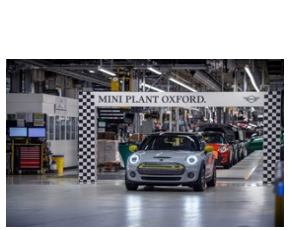
An overview of NEBA

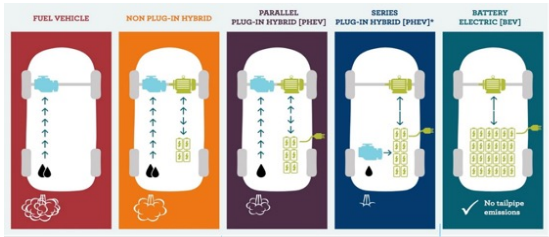
Professor Colin Herron CBE
MD: Zero Carbon Futures (UK) Limited
Newcastle University: School of Engineering
Faraday Institution Office (FINE)
North East Battery Alliance

Lois Warne
Project Manager: Zero Carbon Futures (UK) Limited
Newcastle University: School of Engineering
Faraday Institution Office (FINE)
North East Battery Alliance

Lisa Lewins
Project Coordinator: Zero Carbon Futures (UK) Limited
Newcastle University: School of Engineering
North East Battery Alliance

A brief history of EV in the UK





2020

2021

2022

UK

FINE

NEBA

2017

2009

2011

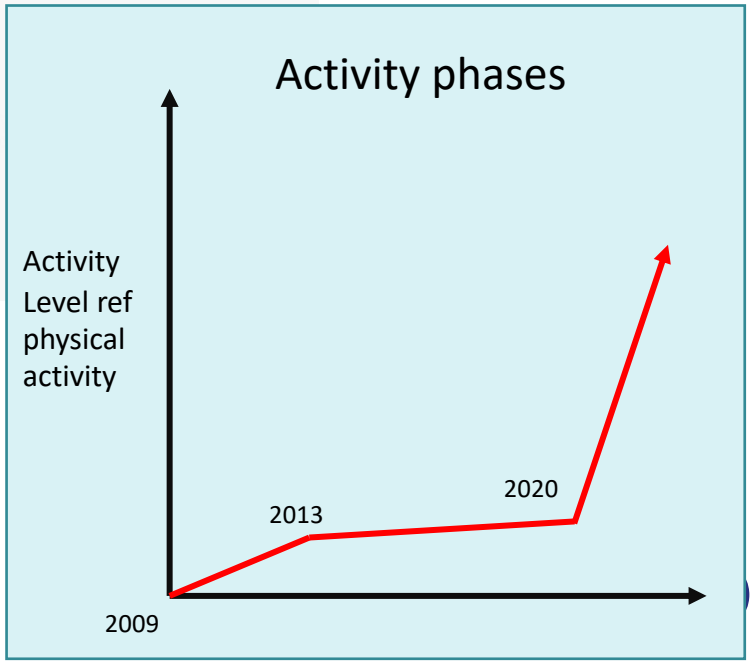
2013

2015

National

Japan

40kWh



Current assets regarding batteries in the NE

Research

THE FARADAY INSTITUTION

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Northumbria University NEWCASTLE

Teesside University

Durham University

University of Sunderland

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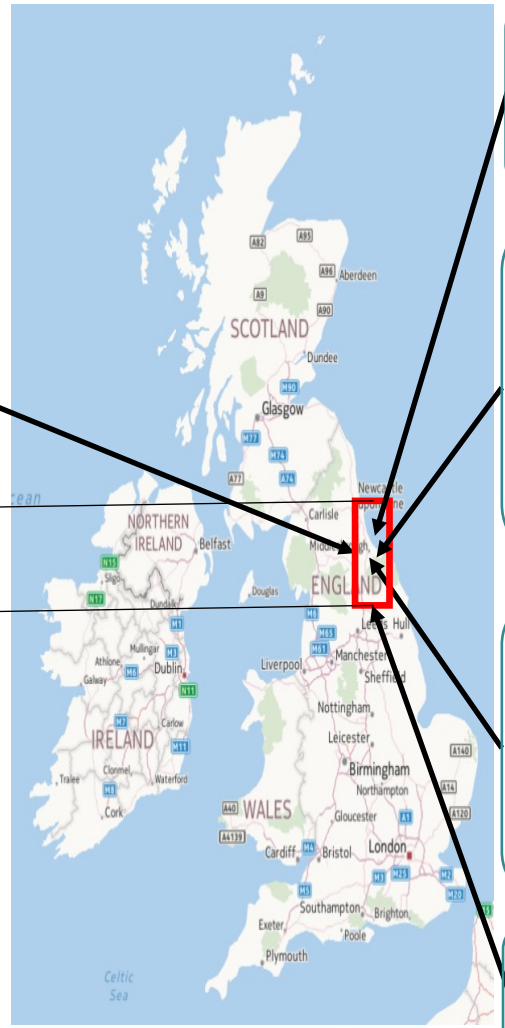
MPI Materials Processing Institute

Excellence in Materials & Process Innovation



NORTHERN LITHIUM

sembcorp

GREEN LITHIUM

Base materials

BRITISHVOLT POWER ON

30GWh

TURNTIDE

saft

ALEXANDER BATTERY TECHNOLOGIES

Envision AESC

27GWh

Cell and pack manufacturing

NISSAN

KOMATSU

HITACHI Inspire the Next

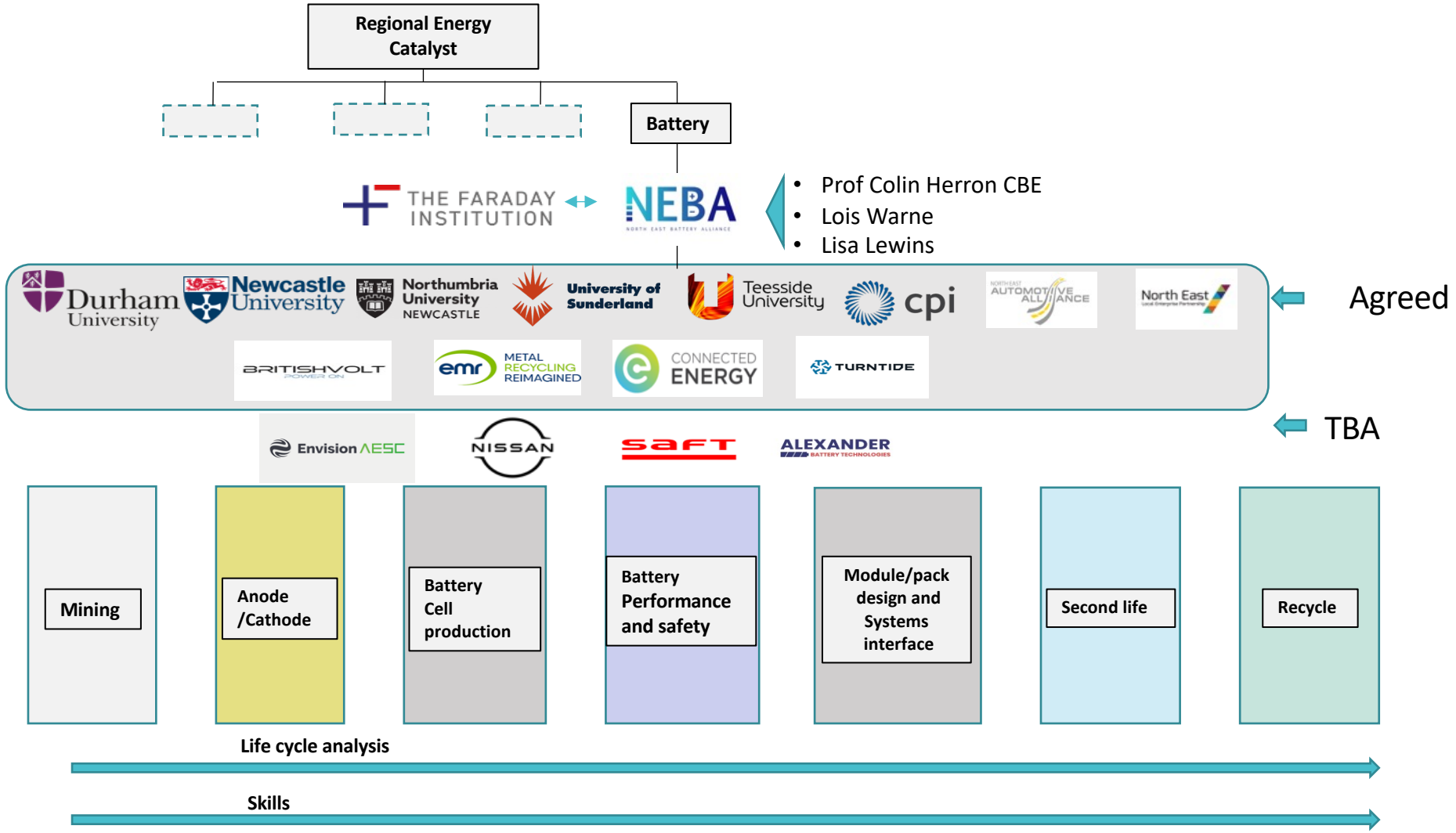
Hitachi Rail STS

Vehicle manufacturing

CONNECTED ENERGY

Second life

North East Battery Alliance Structure



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Tony Laydon

Britishvolt

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The Britishvolt Effect – accelerating the transition to a sustainable society

Peter Rolton 09/03/21

NEBA

Matt Howard

Faraday Institution

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Nissan Leaf

The Faraday Institution

North East Battery Alliance

Matthew Howard
Chief Strategy Officer

11 May 2022

THE FARADAY INSTITUTION

NEBA

Our Mission Areas

The UK's flagship organisation for electrochemical energy storage research, skills development, market analysis, and early-stage commercialisation

Maximising UK Economic Impact of Battery Research

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The Faraday Institution: 4 years of impacts

Positioning the UK as an international leader in battery research

Lead 10 major research programmes

across **24 UK universities** and research partners and **50+ industrial partners**

United a community of 500 researchers

45% new to field, to solve battery challenges through breakthrough science

Training and directly funding 55 PhDs

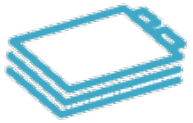
for UK industrial and academic careers, and an additional **82 affiliated** with our projects

Published 410+ scientific papers

63% in top 10% journals
46% in top 10% most cited
50% with international collaborators

Supported 8 entrepreneurial spin-outs

16 industry fellows & **8** industry sprints



Leads a consortium of 7 UK organisations

to develop solid-state battery prototypes

26 inventions identified

3 patents granted and a further **13** in patent process

Shaped policy

through **13 Faraday Insights, 10 major reports, 5 national consultations,** numerous briefings including a House of Commons inquiry and a House of Lords inquiry

Hosted 5 Royal Institution Events

attracting **300,000 online viewers**

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Our community – research partners

UCL

University of Oxford

University of Cambridge

Warwick

Newcastle University

The University Of Sheffield.

Lancaster University

University of Portsmouth

Cranfield University

University of Bath

University of Southampton

University of St Andrews

Manchester 1824 The University of Manchester

University of Liverpool

University of Surrey

The University of Nottingham

University of Sussex

The University of Edinburgh

Imperial College London

University of Birmingham

University of Leicester

Coventry University

University of Strathclyde Glasgow

University of Bristol

diamond

Science & Technology Facilities Council ISIS Neutron and Muon Source

NPL National Physical Laboratory

NEBA

Our community – industry partners

BRITISHVOLT POWER ON
Envision AESC
amte power
CRODA
cpi
Morgan Advanced Materials
cdo²
Deregallera
JM Johnson Matthey Inspiring science, enhancing life
Echion Technologies
WILLIAMS ADVANCED ENGINEERING
UK BATTERY INDUSTRIALISATION CENTRE
ilika accelerated materials innovation
FARADION Advanced Energy Storage Solutions
LG Chem
williamblythe Excellence in chemistry
LMA
TOYOTA
NISSAN
BBOXX
Shell
Rolls-Royce
nexeon
QinetiQ
BENCHMARK MINERAL INTELLIGENCE
Intellegens
MIRA
POTENZA
Pegasus
JAGUAR
LAND ROVER
nyobolt
IMERYS
BMRA
talga
CLAYTEX
ThermoFisher SCIENTIFIC
PIV3 TECHNOLOGIES
ECOBAT TECHNOLOGIES
CARTAKEBACK Scrap Car Recycling
HITACHI Inspire the Next
BREATHE BATTERY TECHNOLOGIES
arcola energy
exawatt
Circular Energy Storage Research and Consulting
ICoNiChem
E+R GROUP
Finden
GRANTA MATERIAL INSPIRATION
delta motorsport
StorTera

Application-Inspired Research focused on

RESEARCH STREAM 1

Lithium-ion

Nearer-term market challenges

Projects optimising current generation lithium-ion based batteries where there are still considerable gains to be made and where breakthroughs could start to be realised in commercial settings within 3-4 years.

In addition, our recycling and reuse project is focused on battery end-of-life and the circular economy.

- DEGRADATION
- MULTISCALE MODELLING
- RELIB
- FUTURECAT
- CATMAT
- NEXTRODE
- SAFEBATT

RESEARCH STREAM 2

Beyond Lithium-ion

Longer-term market challenges

Projects that are higher risk, higher reward and could facilitate the long-term commercialisation of next-generation battery technology that still require considerable research in materials discovery and optimisation.

- SOLBAT
- LISTAR
- NEXGENNA

RESEARCH STREAM 3

Batteries for Emerging Economies

Shorter-term projects focused on reducing the cost and improving the performance of battery technologies for use in developing countries and emerging economies. Funded from UK Aid as part of its Transforming Energy Access (TEA) programme

- RELCo-Bat
- Low-Cost Graphite Polysulphide Single Liquid Flow Battery

April 2018 start | Autumn 2019 start | Oct 2020 start | April 2021 start

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Early-Stage commercialisation

Prioritising and accelerating the commercial value of research arising from Faraday Institution programmes

TSCAN methodology

	Component	Description	Category
T	Technology	Probability of a discovery being available at a given time	Impact
S	Significance	Significance of the breakthrough for the UK economy and manufacturing industry	Benefit
C	Competition	Potential competition, including cost and performance criteria	Impact
A	Action	Activity required to move the discovery to the next stage of commercialisation	Activity
N	Investment	Public and private investment required to reach the next stage	Cost

https://www.faraday.ac.uk/get/insight-13/

Convening academic-industry collaborations

Route to commercialise breakthrough science emerging from research programmes, seeding the UK battery supply chain

First example: assembled **solid-state battery collaboration** of leading UK-based organisations

- Faraday Institution, Johnson Matthey, Britishvolt, UKBIC, Emerson & Renwick, Universities of Oxford and Warwick
- Combining ambitions to develop world-leading prototype solid-state battery technology

Entrepreneurial Fellowships

Supporting entrepreneurs from the UK battery research community

- **Financial and business support to start-ups** in the area of energy storage technology to drive innovation
- **Seed funding, networking and mentoring**
- Support opportunities emerging from Faraday Institution research programmes or other closely related activities
- 7 funded to date
- **Funding to date £640,000**
- Applications welcome at any time

https://www.faraday.ac.uk/opportunities/entrepreneur-fellowship/

Spin out	From University
About:Energy	Imperial, Birmingham
Gaussion	UCL
Cognition Energy	Oxford, Imperial
Qdot	Oxford
Solveteq	Imperial
Breathe Battery Technologies	Imperial
VisIon	Cambridge

The team at Breathe Battery Technologies

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CASE STUDY

GAUSSION: FAST-CHARGING WITHOUT AFFECTING BATTERY LIFE

UCL spin out, Gaussion, commercialising technology that could reduce charge time of EVs by 68% and unlock significant cost savings during cell production at gigafactories

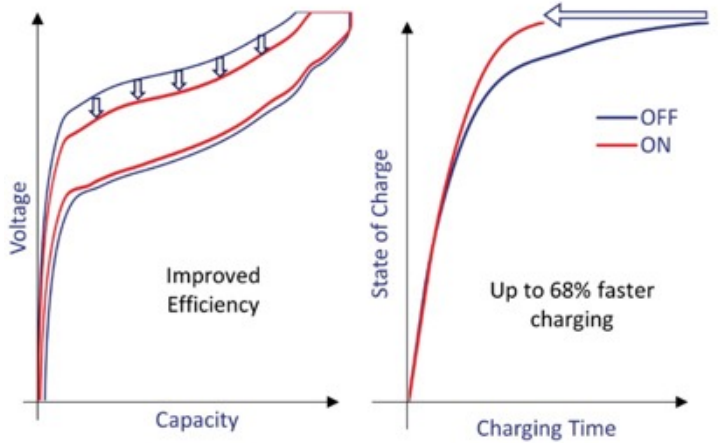
Achievements

- MagLiB technology invented at UCL exposes cells to patented device producing a **dynamic magnetic field**
- Allows higher average electric current during charging, **reducing charge time by 68%** and maintaining energy density and lifetime
- **Faraday Institution Entrepreneurial Fellowship** supported Gaussion
- RSC Energy & Environment Award, Emerging Technologies Competition
- **Ready for real-world proof of concept project**

Potential impact

- Projected revenue from EV rapid recharging by 2026: >£250m
- ~£10m annual cost saving from one 35 GWh gigafactory for a 1% reduction in cell formation time by speeding charge/discharge process

gaussion



A cell charging profile with the device on (red) and off (blue) for a commercially available cell. In this example, use of the **novel technology reduces charge time by a factor of three**.

Industry Fellowships

Fostering relationships between industry & academia

- Establishing collaborative research with benefit to UK battery industry
- Advancing defined research project with commercial potential
- Facilitating university researchers to work in industry settings or vice versa
- 16 funded to date
- Funding to date £930,000
- Successful route in to FI funded programmes from universities not previously involved
- Application deadline 1 April and 1 October each year
- www.faraday.ac.uk/opportunities/industry-fellowship/

University	Industry Partner
Coventry (x2)	Nyobolt
Imperial	Ilika
Cranfield (x2)	Delta Motorsport
Sheffield	PV3 Technologies
Sussex	CD02
Strathclyde	CD02
Birmingham	Echion
Sheffield	Finden
St Andrews	AMTE Power
Sheffield	Exawatt
Imperial	Williams (WAE)
Coventry	Breathe Battery Tech
Imperial	Hitachi High-Tech
Bristol	Thermal Hazard Technology

CASE STUDY

SCALE UP OF LI-ION CELLS WITH UNPARALLELED FAST CHARGING CAPABILITIES

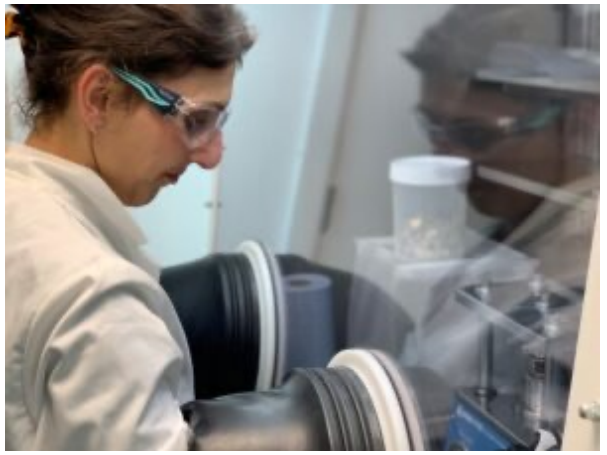
Prototype development by Coventry University Industry Fellowship unlocks £8m investment for Nyobolt Ltd

Achievements

- **Nyobolt Ltd**, a Cambridge University spin out, is developing a **niobium-based anode** material with **fast charging capability** and **high power**
- A **Faraday Institution Industry Fellowship** with Coventry University delivered a rapid transition from small lab cells to **full prototype demonstrator cells**
- Demonstrated potential of Nyobolt materials in commercially relevant cells

Impact

- Protype devices essential to Nyobolt to **secure a £8m Series A investment**
- **Demonstration of a Coventry University-based capability** to rapidly turn around industry relevant prototypes to allow the parallel optimisation of cell chemistry, cell engineering and applications development
- New approaches to cell design and engineering being developed to ensure design does not limit the performance of this new class of materials



Prof Alex Roberts and Dr Agata Greszta of Coventry University's Cell Prototyping Laboratory

Industry Sprints

Focused projects satisfying a need identified by industry

- Short-term research needs identified by UK industry partners
- Projects that lie within the broad scope of Faraday Institution research projects, and which are of wider interest to industry
- Each is affiliated to a main FI project
- Typically 12-month duration
- 8 funded to date
- **Funding to date £1.8m**
- Application deadline last day of Jan, April, July and October each year

https://www.faraday.ac.uk/opportunities/industry-sprints/

University (Industry partner)	Research area
WMG at Warwick, UCL, Leicester	Cell degradation
UCL (OXLid)	Quasi solid-state Li-S cells
Southampton (Thermal Ceramics UK)	Li-ion conducting fibre for composite solid-state electrolytes
WMG at Warwick (Johnson Matthey, JLR)	Screening of electrode manufacturing for soli- state batteries
St Andrews (Morgan Advanced Materials, Ilika)	Supported thin films for oxide electrolytes
Imperial (AMTE Power)	Optimising pack design for thermal management
UCL	Cell abuse, off gas species and related behaviours
Oxford	Materials for thermal transfer

CASE STUDY

AVIATION BATTERY SAFETY SPRINT: UCL AND INDUSTRIAL PARTNER

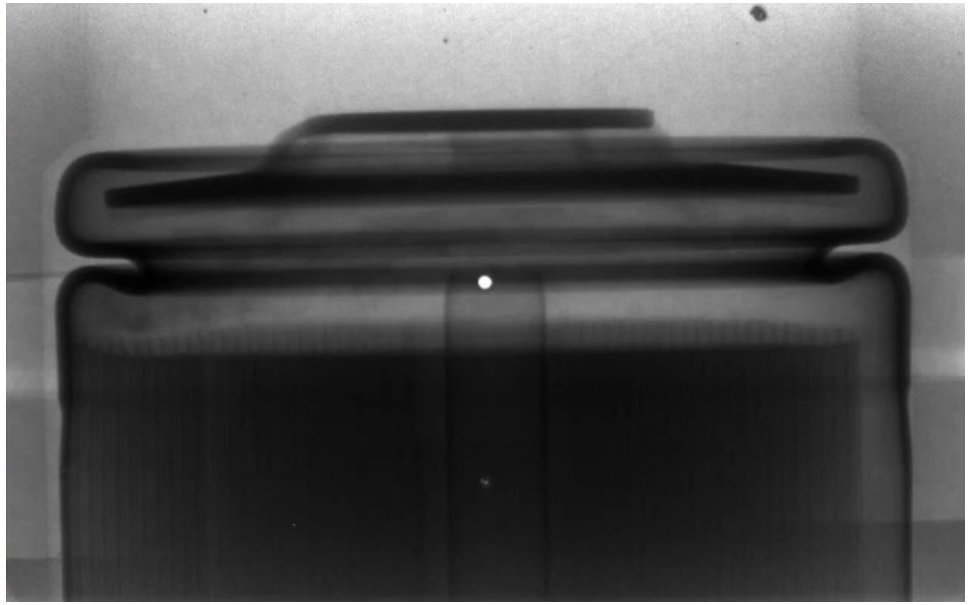
Characterisation of the failure of lithium-ion cells under extreme conditions, with the potential to lead to advances in pack design to control or mitigate the effect of cell failure in aviation applications

Significance and Impact

- Aerospace company needed to **understand the collection of off gases** under certain **battery failure conditions**
- **"Sprint" project** examined the mechanism of failure, gases produced during an event, energy/mass released, and any geometric changes
- Models are being built that could **predict flammability limits**, which will enable a faster, and more efficient pack development processes for aero

Research Details

- Calorimetry combined with mass spectrometry provide details on the mechanism of failure, heat release and gas composition
- X-ray tomography and mathematical models show internal structural differences after failure
- X-ray radiography is used to capture high speed video during failure



Fractional thermal runaway calorimetry and X-ray radiography used to analyse thermal runaway. UCL Electrochemical Innovation Lab (video above)

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Thank You!

opportunities@faraday.ac.uk

https://www.linkedin.com/company/thefaradayinstitution/
Twitter @FaradayInst

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Lucy Winskell

North East LEP

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Lucy Winskell OBE

Chair, North East Local Enterprise Partnership

NEBA

Alexander Rose

DWF

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Levelling Up: Turning rhetoric into action

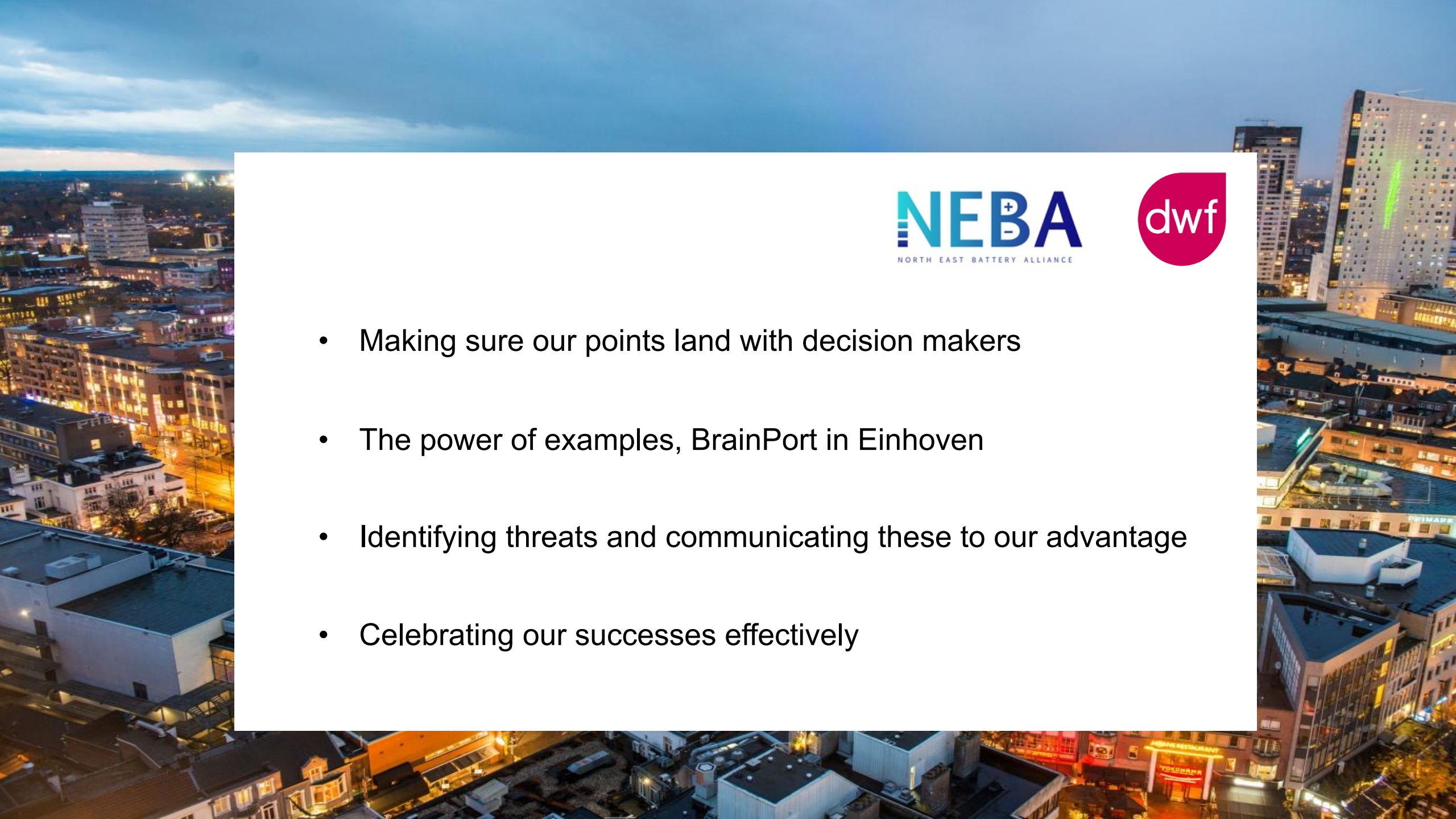
Alexander Rose, Director, DWF

- A great opportunity:

- Post-Brexit law
- the Levelling Up agenda

- Post-Brexit Law
  - examples of opportunities that have been taken so far;
  - how the North East can move onto the front foot and thereby help the Sector.

- The Levelling Up White Paper
  - ATF > Global Britain Investment Fund
  - Mayors > Let them do more, with more
  - The gaps are the opportunities



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NORTH EAST BATTERY ALLIANCE

dwf

- Making sure our points land with decision makers
- The power of examples, BrainPort in Einhoven
- Identifying threats and communicating these to our advantage
- Celebrating our successes effectively

We need to engage with the Levelling Up agenda to get investment.

To secure the lion’s share, we need to have the best ideas and communicate these effectively.

Alexander Rose
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Colin Herron

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Connectivity to the UK

Prof Colin Herron

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Connectivity to the UK

Prof Colin Herron

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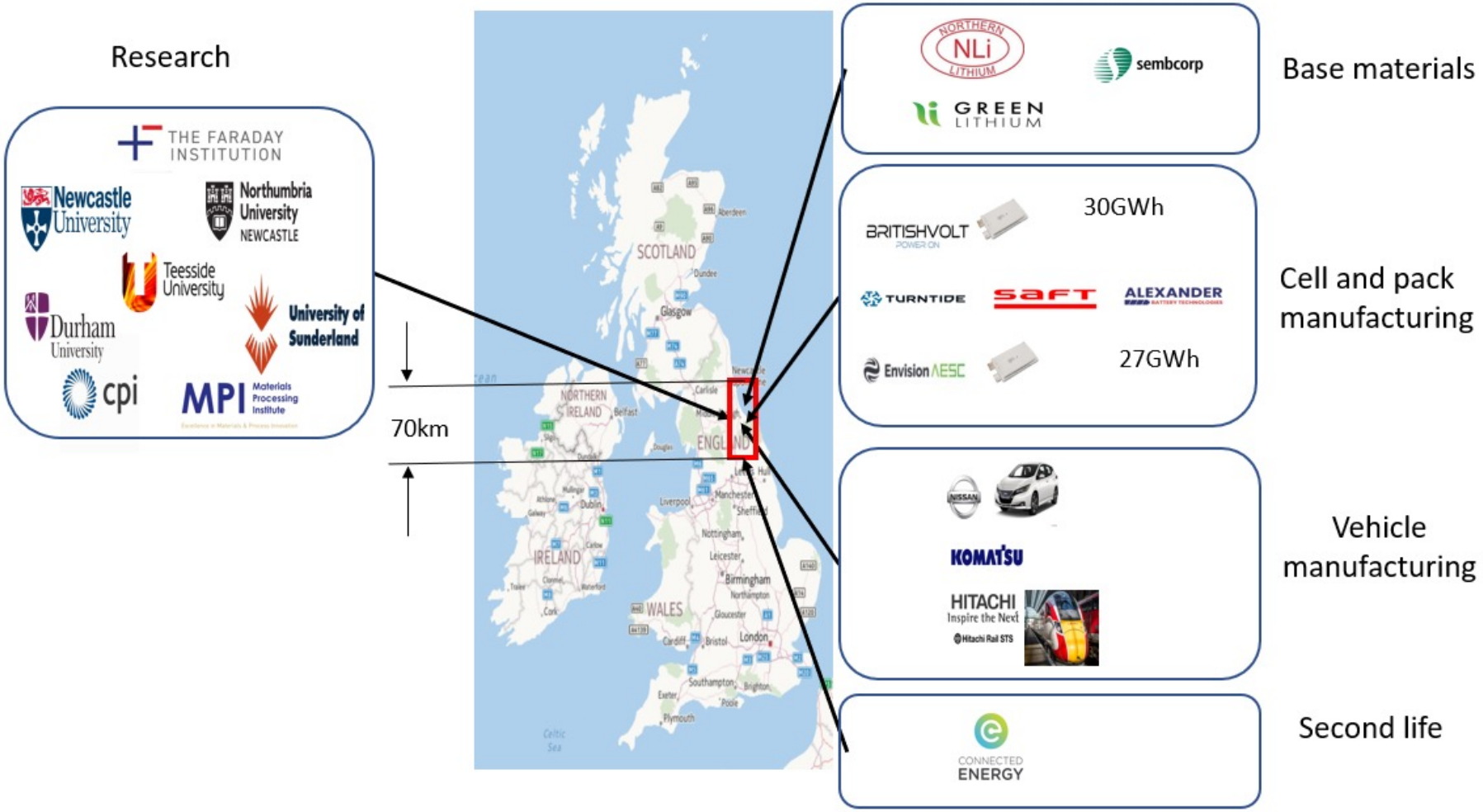
FARADAY INSTITUTION NORTH EAST

AN OVERVIEW OF FARADAY INSTITUTION NORTH EAST

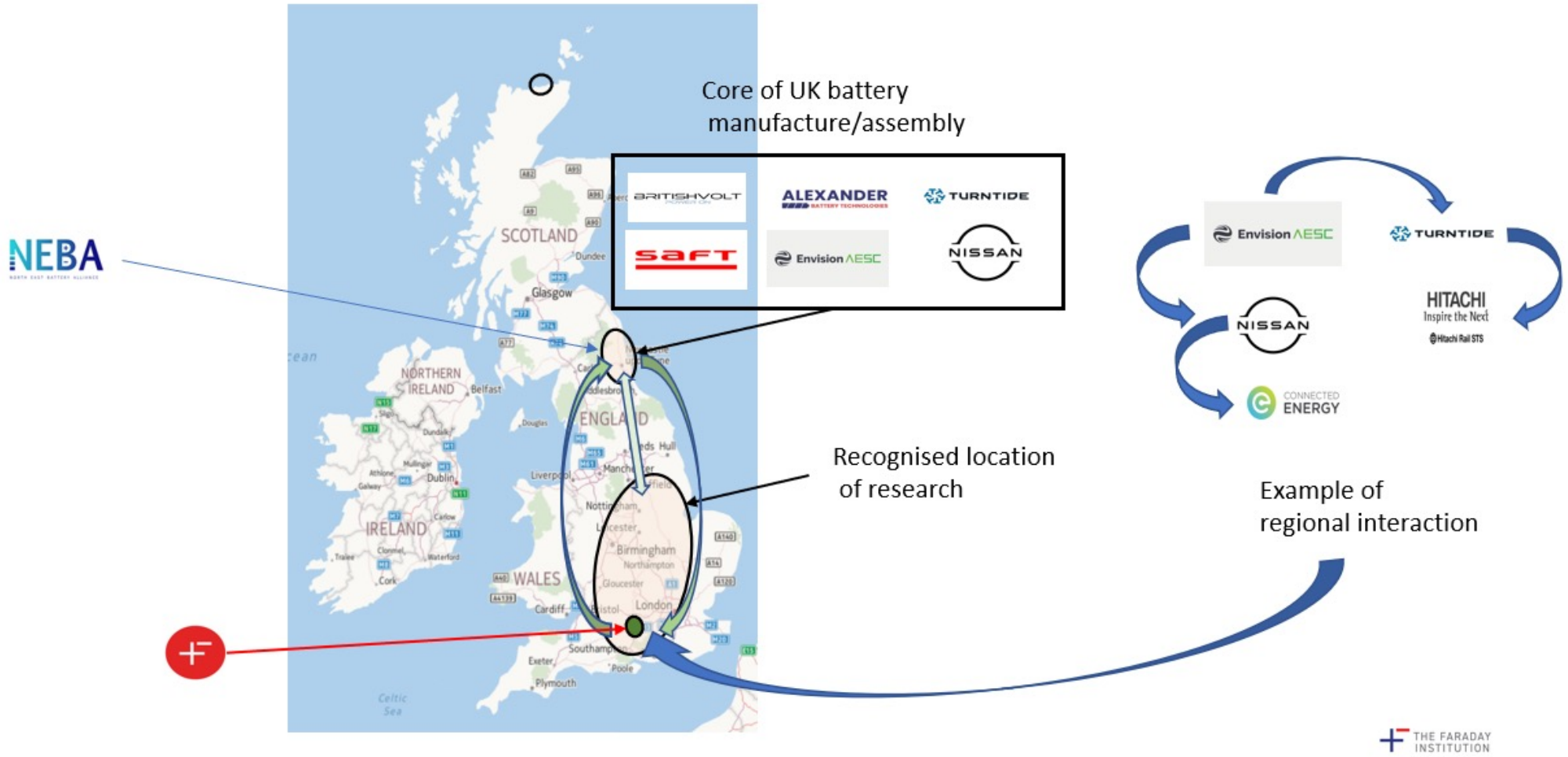
Professor Colin Herron CBE
MD: Zero Carbon Futures (UK) Limited
Newcastle University School of Engineering
Faraday Institution North East Office (FINE)
North East Battery Alliance

Lois Warne
Project Manager: Zero Carbon Futures (UK) Limited
Newcastle University School of Engineering
Faraday Institution North East Office (FINE)
North East Battery Alliance

CURRENT ASSETS RELATED TO BATTERIES



UNITING THE UK



NEBA Progress

PRESENTED BY

Lois Warne

University of Sunderland
Durham University
Newcastle University
North East Local Enterprise Partnership
The Faraday Institution
Teesside University
cpi
Northumbria University Newcastle

What is NEBA

The North East Battery Alliance = A partnership of academia, industry & public sector

Currently, 5 regional universities, one catapult, supported by industry and the public sector

Development project to Mar 2023, led by Newcastle University, aims to identify and build on the North East's existing strengths in electrification, automotive, and advanced manufacturing

Raise awareness of the North East as a leading research hub for the battery industry and attract further inward investment

NEBA Objectives

- To support large scale manufacture of batteries in the North East, including associated supply chains
- Maximising the potential the NE can offer industry in research and skills
- Bring together research institutions to determine our current strengths and capabilities in the area of batteries and identify gaps
- Understand the gaps in the industry for research, skills and future Research, Development and Innovation needs
- Build engagement across the partners
- Identify challenges
- Identify investment needs
- Lobby Government

NEBA

What is NEBA

Encourage collaboration in research to provide a powerful offering to industry regionally and nationally.

- Shape collaboration projects
- Identify funding
- Determine the national image in the battery space
- Future insights, R&D&I needs
- Work across academia, industry and public sector

NEBA

NEWCASTLE UNIVERSITY

- Materials for advanced batteries
- Charging optimisation
- Energy storage test bed
- Charging infrastructure
- 2nd life applications
- Recycling Li-ion batteries
- Battery testing
- V2G charging

NORTUMBRIA UNIVERSITY

- Photovoltaics, energy materials
- Sodium ion batteries
- Anode materials
- Polymer design & synthesis
- Health monitoring
- Defect physics in cathode materials

DURHAM UNIVERSITY

- Developing new materials
- Critical battery metals
- Battery condition, design and life cycle
- Manufacturing process efficiencies
- Energy materials facilities
- Smart grid lab
- V2G Charging

TEESSIDE UNIVERSITY

- Health monitoring for batteries
- 2nd Life batteries for storage
- Power electronics
- Smart grid
- Grid integration

SUNDERLAND UNIVERSITY

- Electrodes
- Composites
- Adhesives
- EV Skills

Plans

A portfolio of regional research capability & capital assets

Determine our strengths in this space to build a regional portfolio of our capability of research in battery related activity:

- Engage with researchers across all 5 universities
- Collect information on research projects, relevant specialisms,
- Previous relevant projects
- Current project
- New project ideas
- Existing / future collaborative work
- Support us to disseminate information to your institutions ensuring we reach all the relevant researchers
- Identify key people to lead collaborative groups for their specialist area

Research capability template developed to share to start this process.

Progress Since Mar 22

Academic Workshops

Objective

- To draw out our strengths and capabilities as a region in lithium ion battery recycling.
- To identify the gaps for research in this area and
- How we can work together to ultimately provide a research hub which supports the growing battery manufacture and development in the North East.
- Discover new project ideas

Format

- Break out groups, 5 questions. 90 minutes. Guided discussion with facilitator
- Discussion and capturing feedback
- Re-group for group feedback, further group discussion, challenges and next steps

Progress Since Mar 22

NEBA Launch event – 2 days

Objective

- To officially launch NEBA and raise awareness of its objectives
- To bring together stakeholders, relevant supply chain organisations, with research and innovation institutions to share ideas
- How we can work together to ultimately provide a research hub which supports the growing battery manufacture and development in the North East.
- Discover new project ideas

Format

- 2 Day event (Academic & Industry)
- Day 1 - Focus on the challenges and opportunities, demonstrate research, explore future pipeline themes
- Day 2 – Industry and supply chain landscape, inform audience of what is going on in the region, explore challenges in battery supply chain, how do we coordinate our activity

NEBA

Progress Since Mar 22

- NE LEP bid & Funding £90k funding, total project £181k total
  - Mar 22 – Mar 23
- 5 regional universities engaged, Battery Groups forming, ***140 academic contacts, and growing***
- Close ongoing collaboration with CPI
- Industry engagement & developing relationships - AESC, Britishvolt, Lithium Salvage, Nissan, EMR, MPI, Green Lithium
- Research Capability Mapping & database
- Local industry & asset mapping working with Faraday Institute and CPI
- Public Sector Engagement
  - NE LEP
  - INEE
  - DiT

Progress Since Mar 22

- Themed academic workshops delivered, 90 attendees, 3 to date 5 more planned
    - FI, EMR, Connected Energy, CPI
- PR and social media

NEBA

What next?

This is a fundamental question which is part of the reason for today. A fire has been lit today and through our chairperson

We will be tackling who, what, and how over the coming months. We welcome your participation as it is a big task!

Email
northeastbatteryalliance@newcastle.ac.uk

NEBA

NORTH EAST BATTERY ALLIANCE

Thank you

Contact:

Colin Herron
Lois Warne
Lisa Lewins

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Graeme Cruickshank

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CPI and the Catapult assets

Dr. Graeme Cruickshank

CTIO & General Manager – Formulation, CPI

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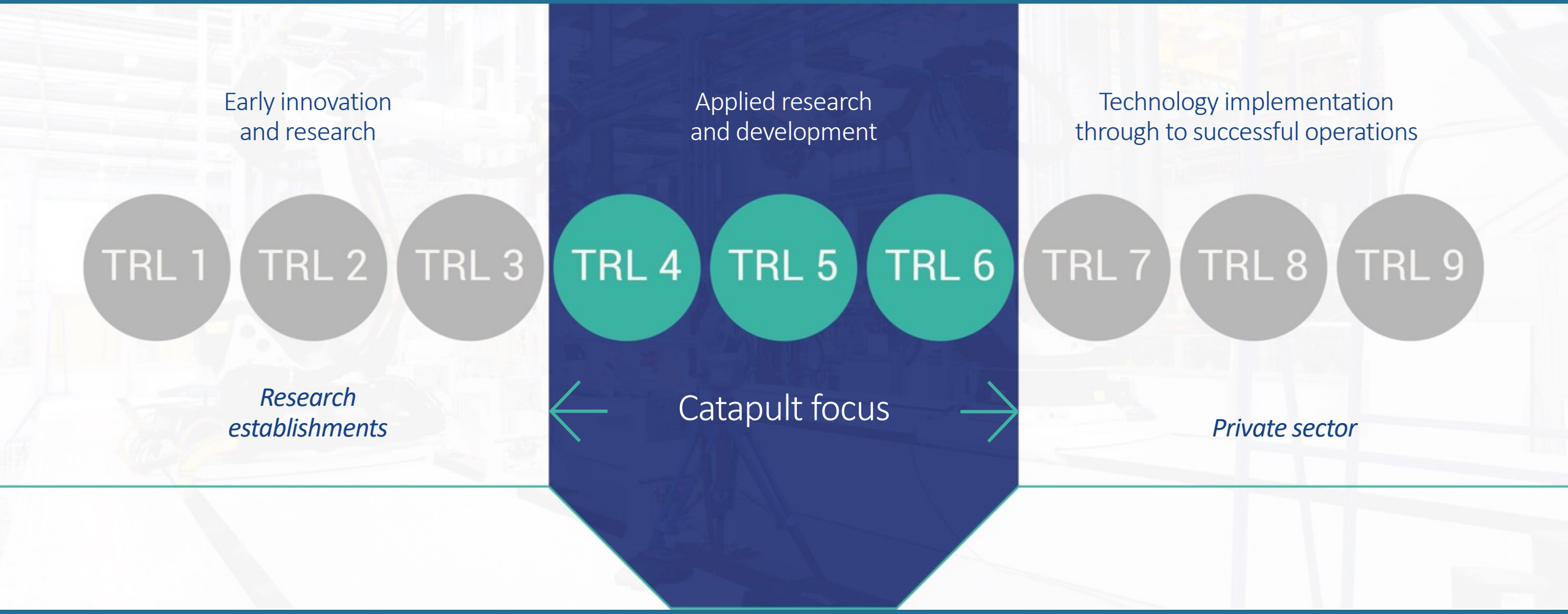
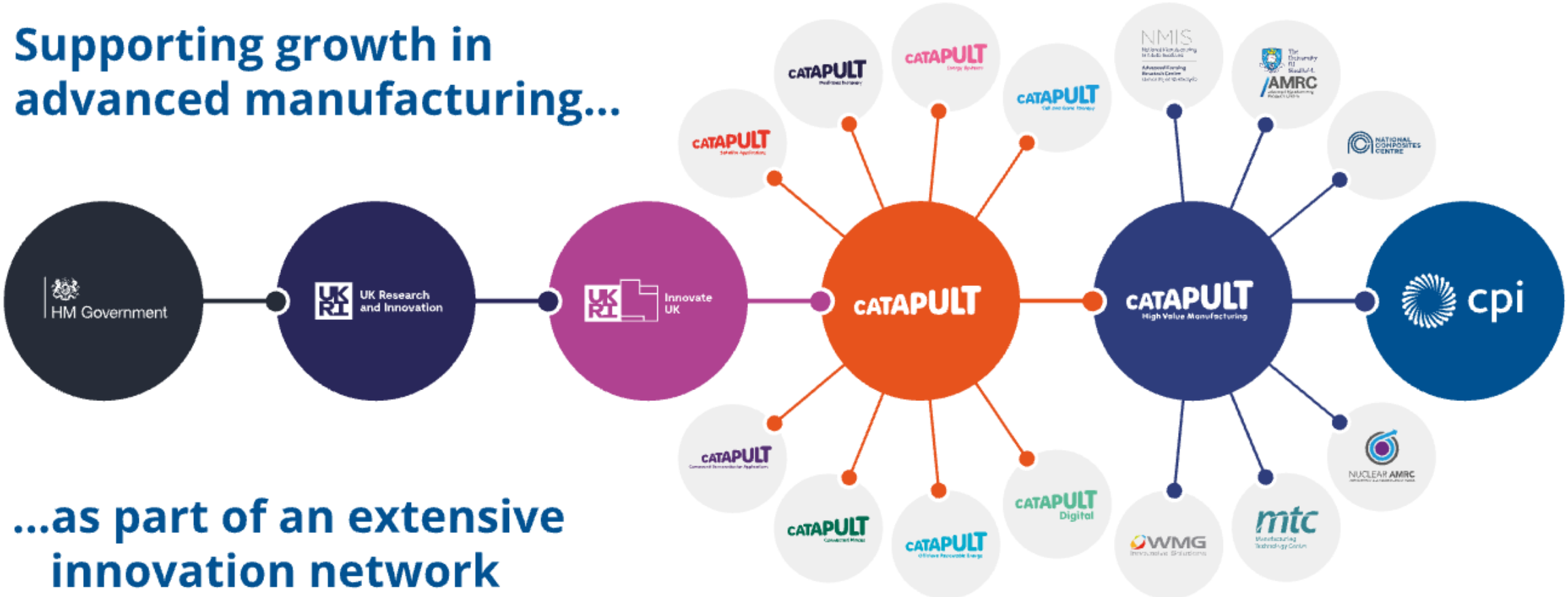

Early innovation and research
Applied research and development
Technology implementation through to successful operations
TRL 1
TRL 2
TRL 3
TRL 4
TRL 5
TRL 6
TRL 7
TRL 8
TRL 9
Research establishments
Catapult focus
Private sector

Supporting growth in advanced manufacturing...



...as part of an extensive innovation network

Our mission

The HVM Catapult is the catalyst for the future growth and success of manufacturing in the UK.

We help accelerate new concepts to commercial reality and thereby create a sustainable high value manufacturing future for the country.

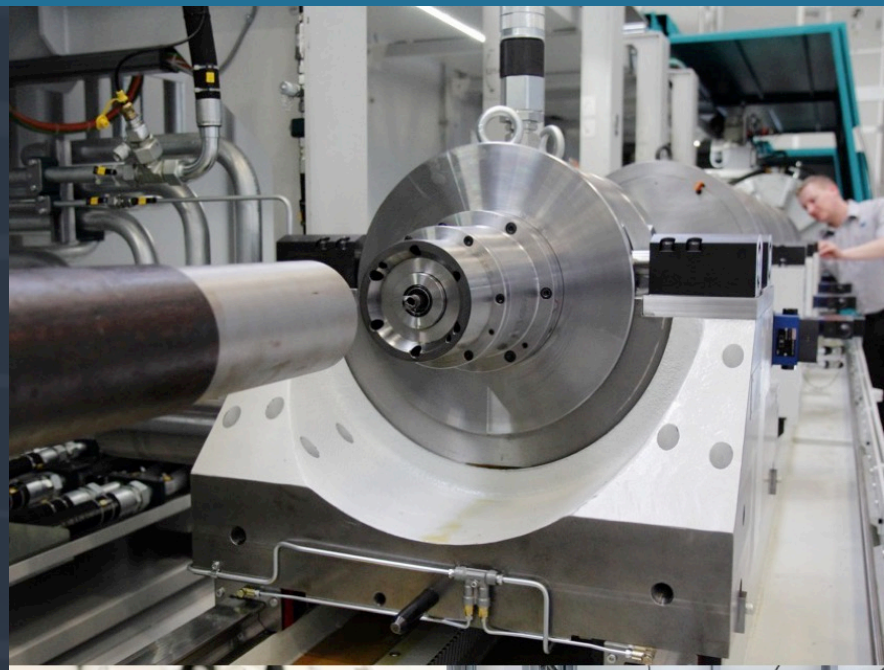
Drive growth of manufacturing

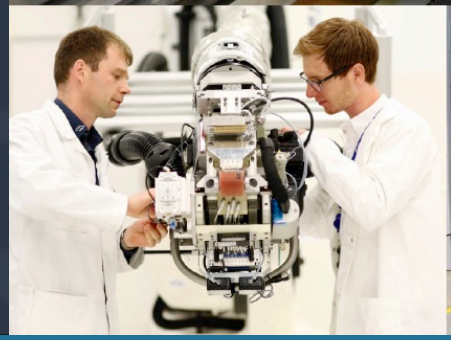
Help companies of all sizes incubate and develop new technologies to commercial reality

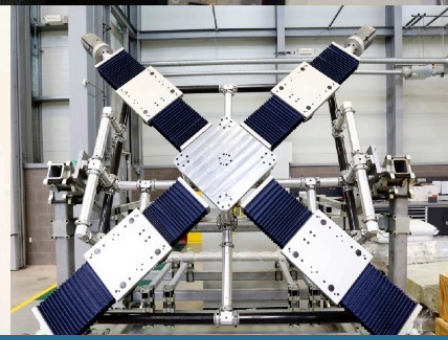
Take the risk out of innovation

Give business access to:

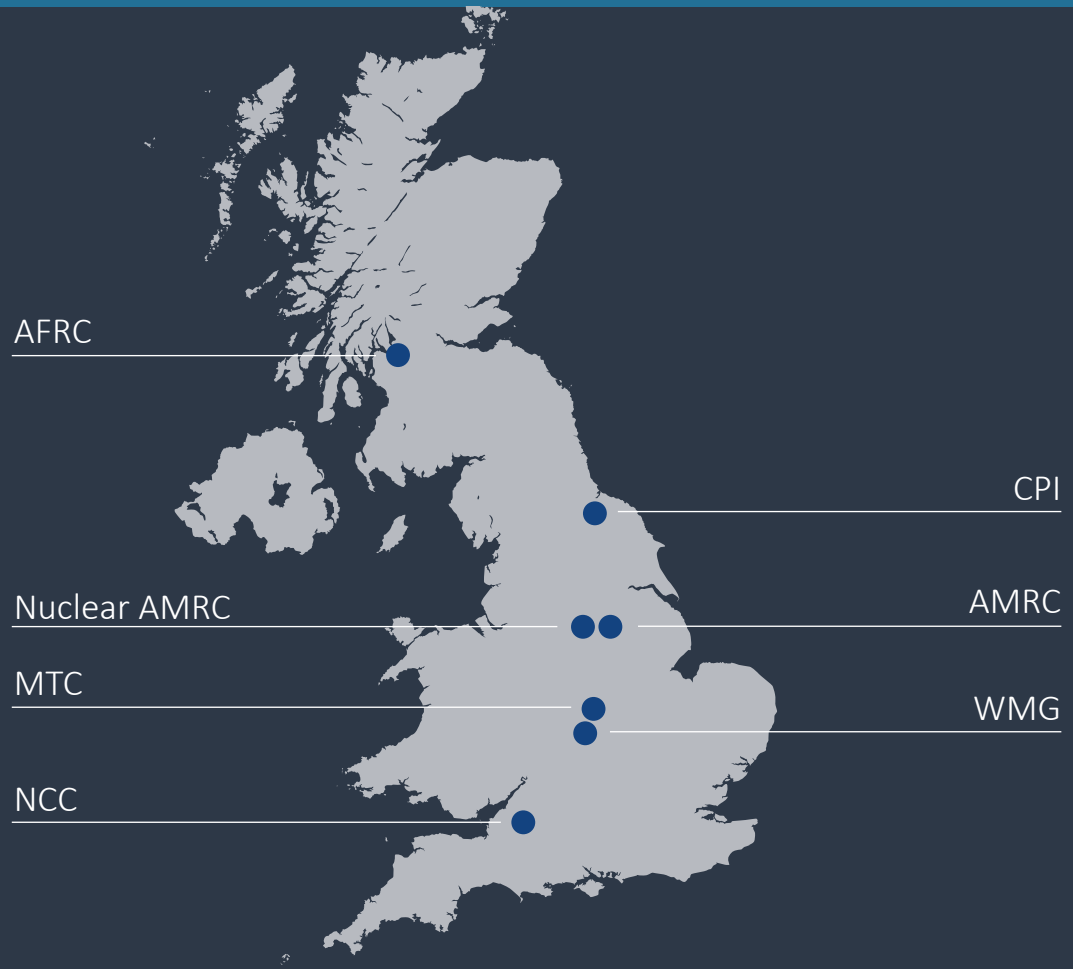
- World class open access equipment
- The UK's best relevant research knowledge
- At elbow support from engineers, scientists, technicians
- An environment of collaboration and open innovation
  - Cross sector
  - Cross technology
  - Whole supply chain
  - Even among direct competitors







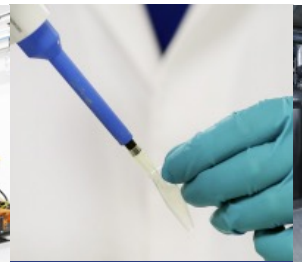
CATAPULT
High Value Manufacturing



27 technologies


Advanced Assembly

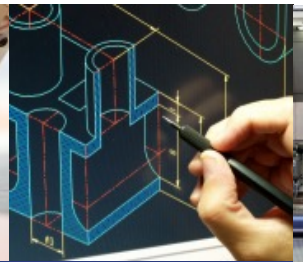

Automation


Biologics

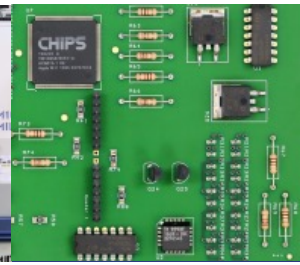

Biotechnology


Casting


Composites


Design


Digital Manufacturing

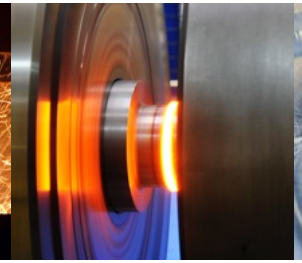


Electronics

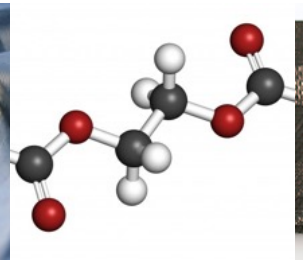

Flexible Manufacturing

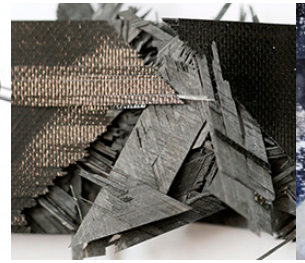

Formulation


High Temperature Processing


Joining

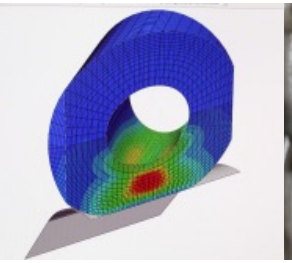

Machining


Polymers


Materials Characterisation


Metal Forming and Forging

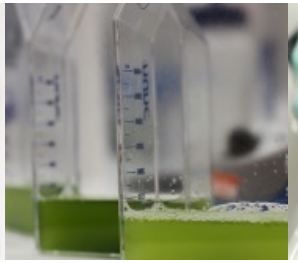

Metrology

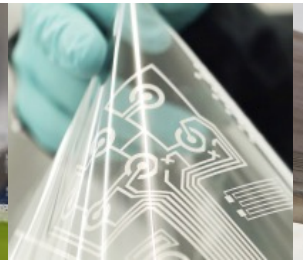

Modeling and Simulation

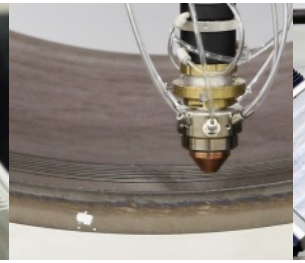

Netshape and Additive Manufacturing

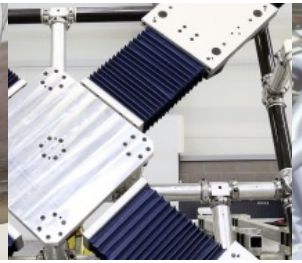

Powder Technology

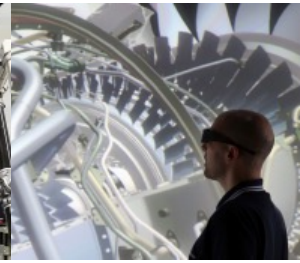

Power and Energy Storage


Resource Efficient and Sustainable Manufacturing


Printable Electronics


Surface Engineering


Toolings and Fixtures


VR and Virtualisation

Home to national centres of excellence in

- Biologics
- Medicines Manufacturing
- Formulation
- Biotechnology
- Electronics
- Photonics









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Proof of concept and scale-up

to prove the feasibility of your new ideas before approaching investors, stakeholders, or funding programmes

Reduce risk

by helping prove and refine your novel technologies before investing further in new facilities and equipment

Decreasing time to market

by providing access to proven demonstration assets and industry expertise

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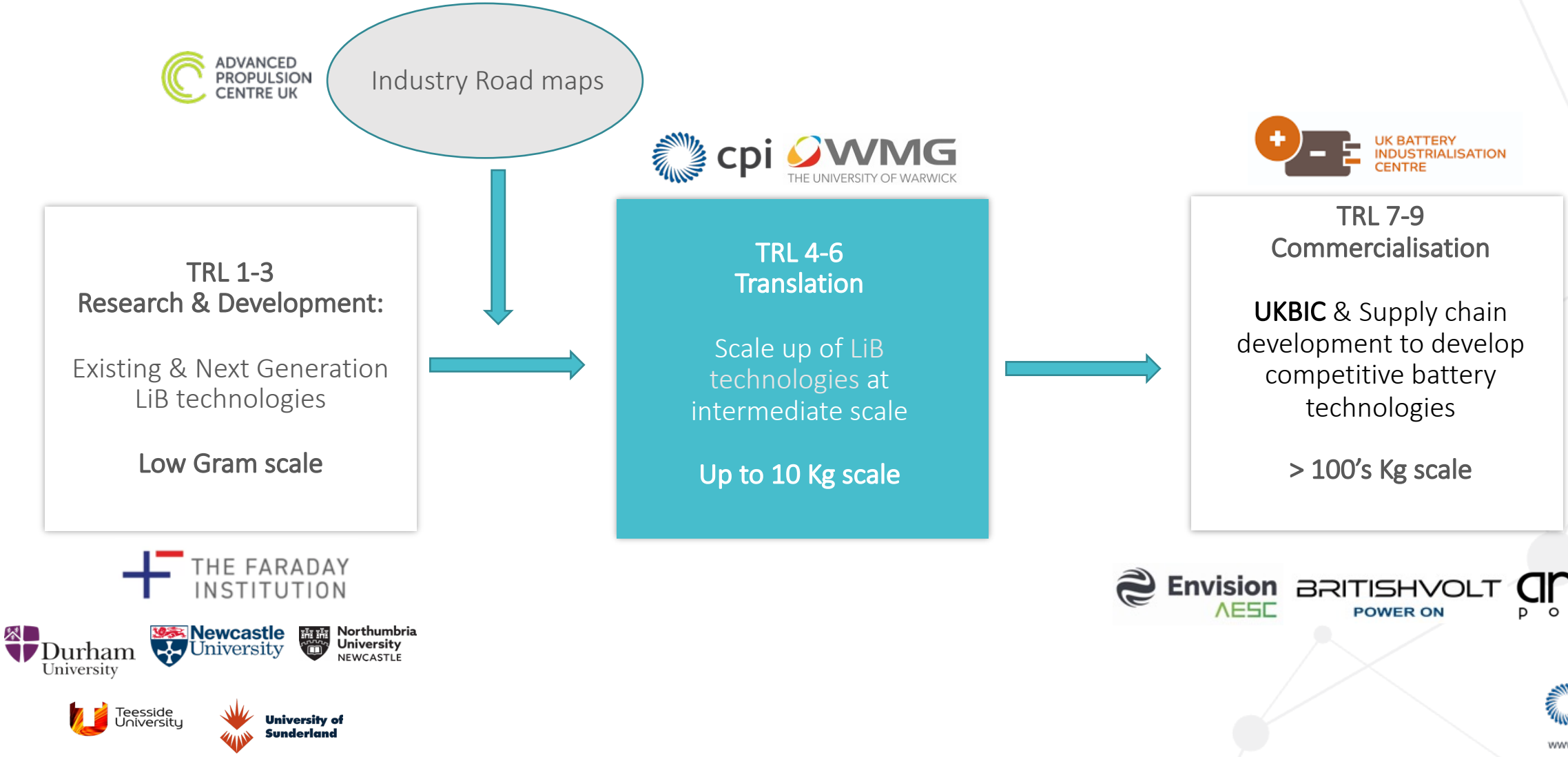
Our battery materials innovation capabilities

UK Battery Ecosystem



Our battery materials offer

Materials

Formulation

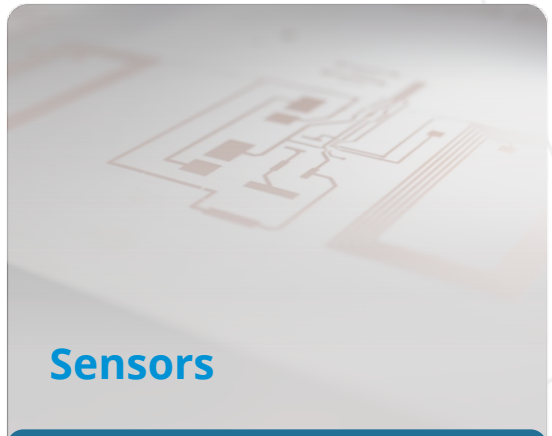
CAPABILITIES

- Utilise **high-throughput experimentation** to screen and optimise existing chemistries
- Processing with a wide range of **mixing technologies** to maximise performance from grams to kilograms
- Optimise the **evaporation and drying of slurrie**s

Coating and structuring

CAPABILITIES

- Wet coating, and vacuum **deposition process** development and optimisation
- Photonic and plasma processing for **improved surface adhesion** and increased efficiency
- Optimisation of electronic **structures and interfaces** to obtain the maximum benefits in electrode performance



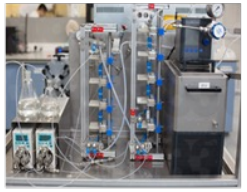
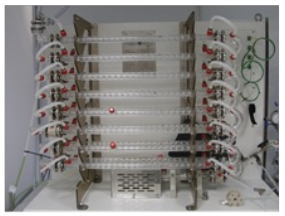
Sensors

CAPABILITIES

- Developing **Integrated and multifunctional smart sensors** for high-value battery management solutions
- Distributed solutions to enable individual **cell monitoring**
- Embedding **intelligent sensors** in cells to better inform second-life applications

Leveraging Assets & Expertise cross the Catapult Network

Synthesis | Formulation | Electrode Fabrication | Cell Assembly | Cell Testing and Forensics

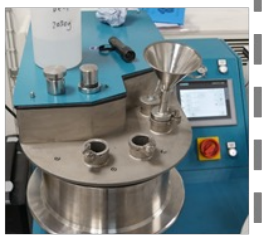






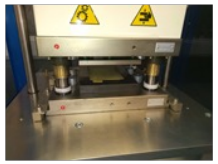










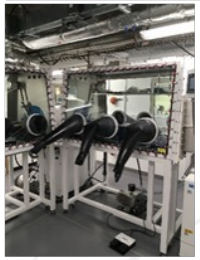
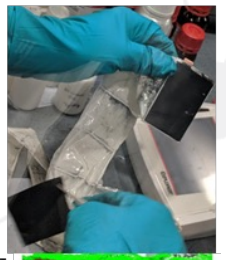
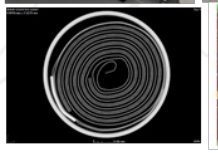
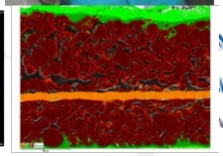










Thank you

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PANEL SESSION

Panel session on identifying the gaps and how to develop into a world leading industrial sector

Ryan Maughan
Panel Chair
EV North

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Lunch Break and Networking

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