North East Energy Catalyst

Funded by

European Union
European Regional Development Fund

NORTHERN POWERHOUSE



North East - Future Energy System Today (North East FEST)

@northeastlep northeastlep.co.uk

Facilitated by

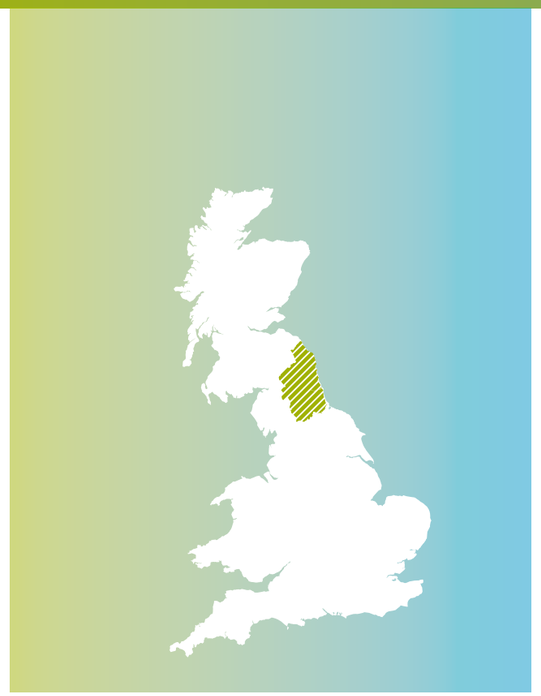
North East Local Enterprise Partnership

In partnership with

Innovation SuperNetwork North East England
British Engines Engineering a Future
Zero Carbon Futures
Catapult Offshore Renewable Energy
Newcastle University
Durham University

Funded by

European Union European Regional Development Fund
Northumbria University Newcastle
North of Tyne Combined Authority
neca north east combined authority
Northern Gas Networks
Northern Powergrid
Northumbrian Water living water



North East England: A catalyst for energy innovation

As the UK builds on its clean growth commitments, the North East is the partner of choice for industry and government to develop and deliver new energy solutions which will drive forward clean economic growth.

Within one region, the North East can both devise and showcase solutions to global energy challenges, **at pace and at scale**.

Playing this national role, and leading the UK's progress as an international leader, presents a transformational opportunity for the North East economy.

Why North East England?

The North East is home to a unique and comprehensive asset base for innovating and demonstrating solutions across the whole energy system. These assets provide world-leading research and a powerful testbed which is used by international businesses, SMEs, and policymakers. The North East's geographic, social, and economic context also offers place-based scenarios for full delivery of these solutions.

The region's mining, engineering and shipbuilding heritage has created a cultural fabric which is intrinsically linked with the energy industry, a societal willingness and a workforce which welcomes innovation and change, and an innovative supply chain which drives forward from this heritage.

Our businesses and research facilities are already working at the cutting edge of developing new solutions, and the region boasts numerous development sites in ideal locations.

The potential **growth** of the UK's **low-carbon economy** pre COVID-19 was estimated at **11% per year between 2015 and 2030** – four times faster than the rest of the economy.

The North East Energy Catalyst

Uniting the North East's leading energy innovation, demonstration and delivery capabilities is a ground-breaking partnership: the North East Energy Catalyst. The Catalyst works to test and demonstrate new solutions at scale, accelerating their wider adoption and deployment. Facilitated by the North East Local Enterprise Partnership (LEP), partners include a powerful and highly collaborative mix of industry, public sector, universities, institutions and government bodies, working together to:

- Tackle major energy challenges and deliver on national policy
- Drive new economic growth opportunities
- Accelerate regional decarbonisation
- Invite and co-ordinate engagement with partners

Our vision

Leveraging the unique opportunity presented by our assets and place, the North East Energy Catalyst will:

Develop and showcase solutions to global energy challenges, via innovation demonstration and delivery.

The North East will act a catalyst region, both devising the solutions to key future energy challenges, and deploying them at pace and scale to accelerate wider adoption.

Our Catalysing Change Challenges

The North East Energy Catalyst has identified three central challenges which will deliver on our vision. These are global energy challenges which require continuing innovation and rapid deployment of solutions at scale:

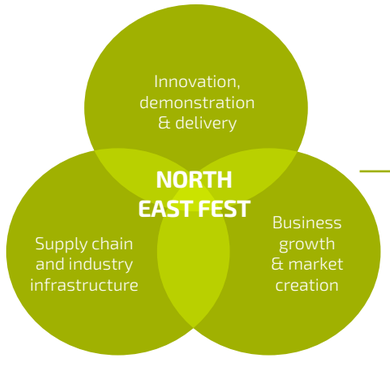
Maximising the deployment and life cycle value of low carbon **power**	Commercialising and deploying scaled pathways to decarbonise **heat**	Industrialising and mainstreaming the technology to decarbonise **transport**

North East Future Energy Systems Today

We are tackling these challenges through a programme of projects we call our North East 'Future Energy Systems Today' programme (North East FEST).

The programme will work to deliver large-scale solutions to these global energy challenges through innovation and demonstration and aims to drive growth in the North East.

By sharing our learning to accelerate wider change we will help catalyse the creation of global markets in sectors of opportunity for both our region and the wider UK.



- Maximising the deployment and life cycle value of low carbon power
- Commercialising and deploying scaled pathways to decarbonise heat
- Industrialising and mainstreaming the technology to decarbonise transport

Our Catalysing Change Sectors

Our Catalysing Change Challenges are not only areas where the North East can lead in showcasing solutions to global energy challenges, but also drive growth in sectors crucial to levelling up the region and transforming our economy for years to come.

Offshore wind in the North East could **support up to 9,000 jobs by 2025** and generate up to **£180m** in GVA

Offshore wind

A critical form of low carbon power for the UK to optimise is offshore wind. The North East is identified by the offshore wind sector deal as a key cluster for delivery nationally and is home to a world-leading cluster of sub-sea engineering, technology, and offshore energy supply chain and industry leaders.

The region is an international centre for offshore wind innovation, testing and validation, facilitating unique opportunities to explore how wind can maximise its value in the energy system – for example, through advanced manufacturing and robotics, driving innovation and SME growth, floating wind, and integration with other energy vectors including hydrogen.

Key operations for the world's biggest offshore wind farm, Dogger Bank will be hosted here in our region.

The UK heat networks sector could create up to **35,000 direct additional jobs by 2050**

Decarbonised heat

A large-scale opportunity emerging from the North East's energy innovation and delivery opportunities is the decarbonisation of heat and heat networks, with a major pipeline of projects under active development and an ambition to become the UK's first internationally known heat networks cluster.

The North East has also been identified with the Department for International Trade (DIT), and Department for Business Energy and Industrial Strategy (BEIS), as a high potential opportunity for associated investment in the sector, as it grows to service the necessary demand in the UK and globally.

The region is home to an engineering skills base, a strong supply chain, development sites and international connectivity, and is also pioneering new low carbon heat pathways, such as the UK's first and largest mine energy schemes, national trials to utilise hydrogen as a fuel for heating, and electrification of heat using hybrid heat pumps.

The UK could create up to **78,000 new jobs by 2040** in battery supply chain and EV manufacture.

Decarbonised transport

Leveraging the region's energy innovation and demonstration strengths, and linkages to the automotive sector, the region is at the cutting edge of battery and EV manufacture.

The North East is home to Europe's first gigafactory, with opportunities to expand capabilities with further gigafactory sites, we also host an extensive chemical and materials sector which can develop and support next-generation battery technology supply chains.

The region is also home to the most successful electric vehicle in Europe, the Nissan LEAF, and a cluster of sector-leading businesses which are developing and supplying electrified power train and battery technologies to the automotive sector. There is huge growth potential in this sector, with regional activity proactively supported by the North East Automotive Alliance, the UK's largest automotive supply chain industry body.

Additionally, building on the North East's subsea capability, businesses in the region are leading the way in the sourcing of low cost, environmentally friendly raw materials for electrical vehicle batteries, further bolstering the next generation battery supply chain.

Our track record of delivery

The North East has a strong track record of delivering a bold programme of investment, collaboration and change in energy and clean growth, which is firmly at the heart of the region's long-term economic strategy.

The North East's Strategic Economic Plan highlights energy as an area of strategic importance to the regional economy, and energy and clean growth formed a key element of the region's Local Industrial Strategy submission to Government. They are now central to the North East's COVID-19 recovery plan to ensure a green recovery, with interventions across business support, job recovery, community resilience and digital and connectivity investment.

The North East Energy Catalyst helps optimise this delivery environment, facilitating innovation-led activity and using this to influence and inform wider regional programmes and investments.

North East partners are investing almost £200m over the next 10 years towards a programme of activity, which is leveraging further public and private investment, to:

- Unlock the potential for accelerated growth in our energy sectors – building on world-class assets and supply chain, as part of a North East-wide Energy for Growth strategy.
- Create the conditions for radical innovation across our industries and public services – supporting collaborative, market-led interventions that create new jobs and demonstrate bold ambition around carbon reduction.
- Grow our capacity as a region to build the skills base to support new jobs and a transition to a green future economy.
- Investing in the capacity of citizens, communities, businesses and public services to inspire changes to the way we live, work, travel and communicate.

Our energy innovation and demonstration assets

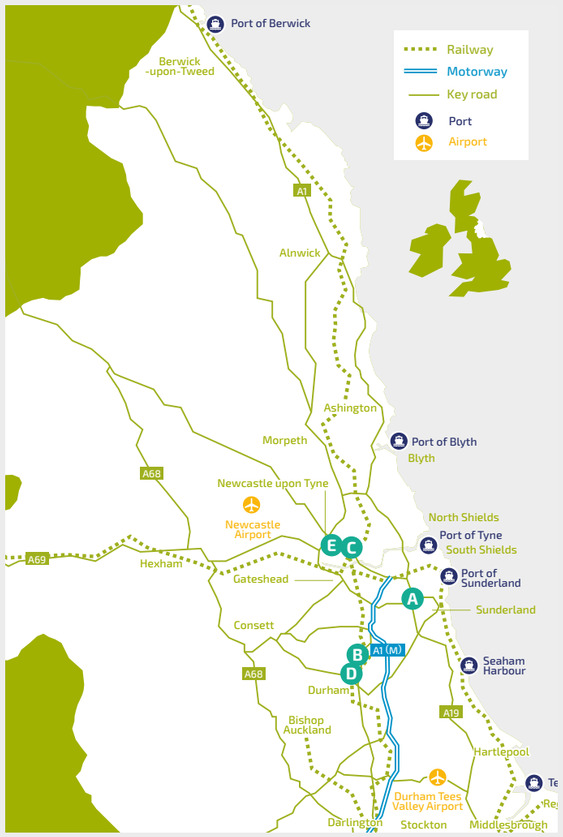
The North East's innovation demonstration and delivery assets span multiple energy vectors, their integration as a whole energy system, and the materials which comprise or enable them. Our assets include physical facilities, 'real-world' delivery opportunities, and multidisciplinary science, policy research and development activities.

Through the Catalyst we coordinate these assets, in order to add value, make them available nationally and internationally as a coherent pathway, and to work towards tackling our Catalysing Change Challenges.

Our energy innovation programmes

The North East Energy Catalyst also delivers programmes, including our Energy Innovation Challenge. This utilises the industry networks and knowledge of the Catalyst to identify key sector innovation challenges, launching them into the region for our innovative SME base to respond to with solutions and receive expert business support and investment opportunities to bring their ideas to market. Through this programme we foster and maintain our Catalyst SME network, and support regional businesses to access the sectors related to our Catalysing Change Challenges.

Heat



C Newcastle City Council (with the North of Tyne Combined Authority)

- **Electrification of heat** - A project demonstrating large scale feasibility of new heat pump technology (250 households).

Find out more

A Northern Gas Networks

- **HyDeploy** - blending of 20% hydrogen into 670 homes in Winlaton from December 2020

Find out more

B Northumbrian Water Ltd

- **Advanced anaerobic digestion facility** – Tyneside (Howdon)
- **Biomethane purification plant** – Tyneside (Howdon)

Find out more

D Durham University

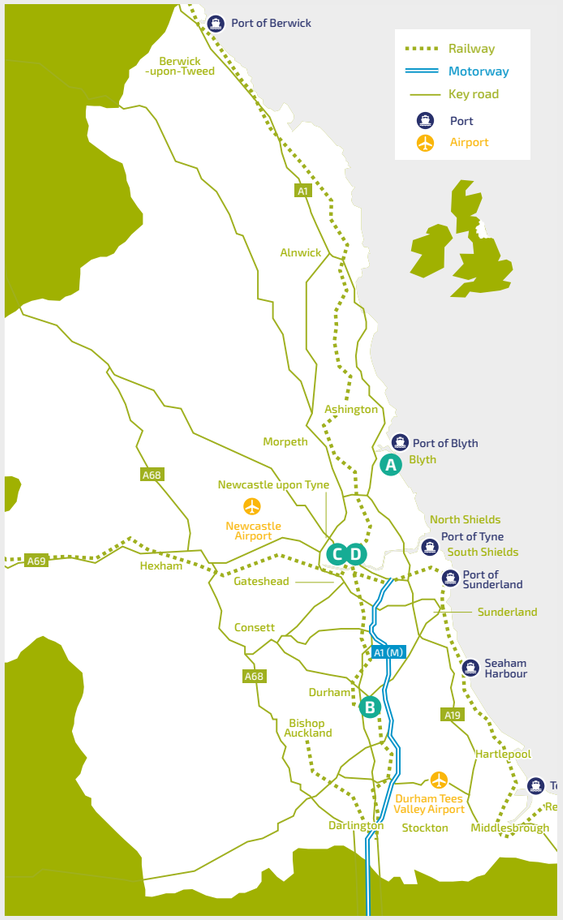
- **Hydrogen for heat laboratory** - Facility to demonstrate hydrogen fuelled heating, storage and power.
- **Advance thermochemical systems laboratory**
- **Zero emission CHP and powertrain laboratory**

Find out more

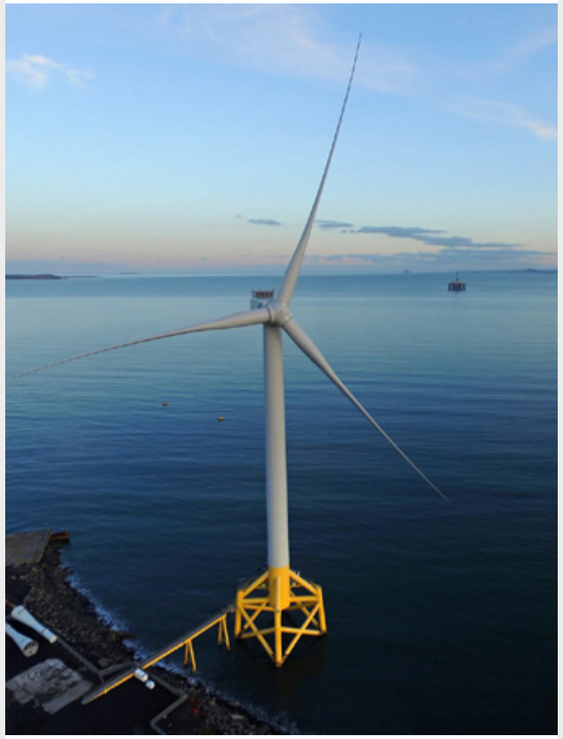
E Newcastle University

- **Grid-scale pumped heat energy storage system**
- **Net Zero GeoRDIE** - 1.6km deep borehole research and demonstration asset Investigating closed loop deep well geothermal energy.
  Find out more
- **Helix** - A 24-acre city-centre testbed and collaborative ecosystem for public and private bodies.
  Find out more

Power



A Offshore Renewable Energy Catapult



- **3 MW powertrain test facility** – primarily designed for full scale tidal turbine nacelle testing, this flexible facility can provide axial torque plus non-torque loads to test all six degrees of freedom (DOF) with mechanical Hardware In the Loop (mHIL).
- **15 MW powertrain test facility** – primarily designed to test the next generation of full-scale wind turbines. It can provide 6 DOF to accurately recreate wind conditions along with its mHIL.
- **eGrid** – an 18 MVA rated, grid emulation system which can connect to either facility above or allow full grid compliance testing of the device(s) under test.
- **Levenmouth demonstration turbine** – A 7 MW offshore wind turbine available for demonstration of new technologies and equipped with a plethora of sensors and high-speed data recorder.
- **Met masts** – Two fully equipped met masts, located at separate offshore wind turbine/farm locations.
- **Wind turbine converters** – ORE Catapult has a selection of commercial scale wind turbines.

Find out more

B Durham University Smart Grid Lab

- **Demand-centric testing** – from smart meter to smart home, with sensors and appliances, and capable of testing demand response programme.
- **Decentralised testing** – from p2p energy trading to micro grid and smart grid, with 2 RTDSs and Opal RT, renewable energy emulators etc.
- **Digitalised and data-centric testing** – Machine learning and artificial intelligence, with in-house super computers with water cooling systems and dedicated ML/AI software.
- **Energy conversion and drivetrain research laboratory**
- **Wind tunnels** - An extensive array of wind tunnels which can be used for wind turbine and vehicle testing. The largest wind tunnel features a turbulence generation system capable of producing repeatable unsteady flow events.

Find out more

C Newcastle University Smart Grid Lab

The focus of Newcastle University's Smart Grid Lab is the simulation of distribution networks under future scenarios.

An integral part of this system is a real-time network simulator (RTNS). This allows for detailed real-time simulation of networks using sophisticated models that can interact with the physical laboratory environment.

- **400 V 3 phase distribution ring** - connected to various devices. Energised by 3 phase motor/ generator or flexible power convertor.
- **Physical laboratory equipment**
- **AC/DC converters with flexible control systems**
- **Models and data** - which enable simulation and experimentation on local regional, and national energy systems.

Find out more

D Northumbria University

Power research programmes and projects at Northumbria University include:

- **Renewable energy and power lab** - grid integration of renewable energy and electric vehicles, smart grids, wireless charging, wind energy conversion systems, electric drives, power quality, advanced control systems and industrial processes. This laboratory has a wide range of testing equipment and instrument for simulation of grid integration, power quality and renewable energy technologies.
- **Physics and electrical engineering projects laboratories** - a wide range of equipment for test and measurement and industry standard software including Python, NI LabVIEW, Matlab Simulink and PVSyst.
- **Oswald supercomputer** - High performance computing cluster with 896 cores (Dual Intel Xeon E5-2680 v4, 2.4GHz CPU, 64GB RAM, 120GB SSD) for processing, a GPU node (NVIDIA Tesla V100, 640 Tensor cores, 5120 CUDA cores), and 88TB Lustre Parallel storage, which allows the Unit to address computationally demanding research problems. Find out more

Transport

A Newcastle University

- **Driving the Electric Revolution (DER) Centre**
- **Newcastle Helix fast charging stations (Fastned)** - up to 175kW enabled for 350 kW, monitoring linked up to University's Urban Observatory.

Find out more

B Sunderland City Council

- **Fast charging stations (Fastned)** - four 50kw fast chargers, two 175kW enabled for 350 kW.
- **EV Gigafactory (Envision) battery plant**
- **International Advanced Manufacturing Park (IAMP)**

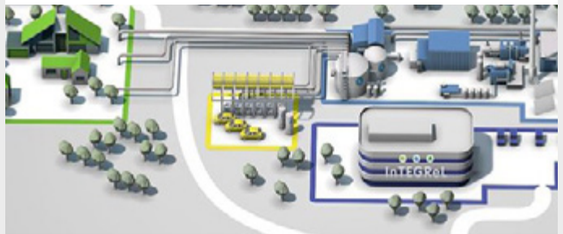
Find out more

C Newcastle City Council (North of Tyne Combined Authority)

- **Newcastle Helix fast charging stations (Fastned)** - up to 175kW enabled for 350 kW.

Systems

A Northern Gas Networks



- **InTEGReL** - A fully integrated whole energy systems development and demonstration facility, providing a space for industry, academia, SMEs and government to explore and test new energy technologies, strategies and processes.
  - Customer Energy Village
  - Grid Scale Battery
  - Solar Array
  - Hydrogen electrolyser

Find out more

C Newcastle University

Work at CESI investigates the challenges of energy supply, sustainability and affordability.

- **Cockle Park Farm** is a 307 hectare mixed farm owned by Newcastle University. Activity on the farm includes:
  - Grid connected anaerobic digestion
  - Net Zero Farms and low emission farm vehicle research

Find out more

- **The National Centre for Energy Systems Integration (CESI)** Work at CESI investigates the challenges of energy supply, sustainability and affordability. Including:
  - Future supply and demand flexible smart infrastructure to empower customers, and achieve decarbonisation, driving cost efficiency from integration of energy vectors.
  - Urban Sciences Building (smart sensored and instrumented building with advanced BMS).

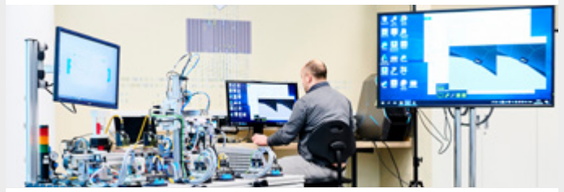
Find out more

B Durham University

- **Smart Grid Laboratory -** Hosting a low-voltage network with wind turbine, EV, Solar emulation system and a wide range of other low carbon technologies. Also hosting a suite of Power Systems Real-time Digital Simulators (including RTDS and Opal-RT) for advanced real-time simulation and integration, control studies.

Find out more

D National Innovation Centre for Data (NICD)



- **MindSphere laboratory -** in collaboration with Siemens. Launched to to accelerate digitalisation and meet the needs of an increasingly-digitalised society. The laboratory uses cyber-physical research assets to uncover new business models, create commercial opportunities through digitalisation, and build evidence for change in how we manage our built environment.

Find out more

E Offshore Renewable Energy Catapult, Durham University and Newcastle University

- **Integrated Smart Energy Lab –** The world's first muti-site integrated smart energy lab. Connected physical, digital and intellectual smart grid assets which can develop and demonstrate a vast array of solutions and scenarios, across all grid levels. Capable of connecting physical assets in real-time.

Find out more

Materials

A Tyne Pressure Testing

Testing facilities include:

- Service and Research to the Power, Nuclear, Defence and Oil & Gas Sectors;
- Hyperbaric (up to 15,000 metres), one of the world's largest chambers.
- Hydrostatic, Gas & Endurance testing
- High and Cryogenic Temperature (-160°C to +250°C)
- Product qualification/verification, certification and factory acceptance testing (FAT); API 6D, API 6DSS, API 6A, API 17D, API 17F, API PR2
- Destructive testing
- Control system testing including Flushing
- Buoyancy loss testing
- Bespoke testing services, including Assembly facilities
- Part of the British Engines group based in the North East with access to:
  - Extensive experience, research and development in cable termination and containment in safety critical environments
  - Valve environmental and fugitive emissions testing
  - Hydrodynamic bearing solutions for the Power, Nuclear and Defence sectors
  - Specialised sub-contract machining facilities for the Nuclear, Defence, Aerospace, Power, Oil and Gas sectors.

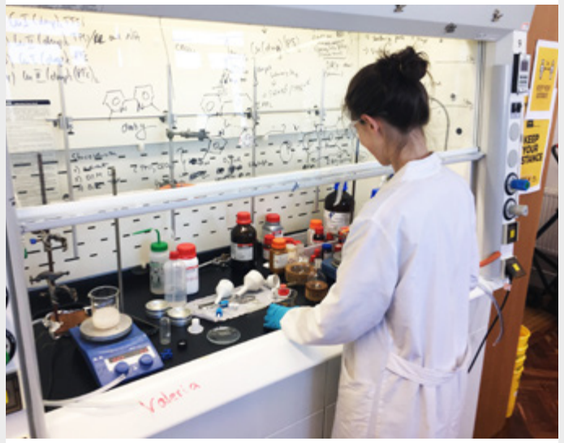
Find out more

B Durham University

Materials reseach here includes:

- **Supercomputing cluster** – Hamilton – which enables cutting-edge computational research on PV materials and devices.
- **Superconductor characterisation high-field laboratories** Find out more
- **Fusion diagnostics and superconductivity facilities in Centre for Advanced Instrumentation** Find out more
- **Split-pair helmholtz 15 tesla magnet system** - with probes for making critical current measurements as a function of field, temperature and strain. Find out more
- **Centre for Molecular and Nanoscale Electronics** - Research facilities include electrical (J-V, noise), optical (UV-vis) and device (Solar Simulator, external quantum efficiency, environmental chamber) characterisation; structural and morphological probes; together with fabrication facilities such as nanoparticle synthesis, spin-coating, glove-boxes and evaporators.

C Northumbria University

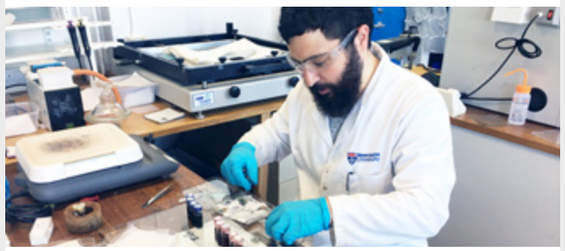


Northumbria University research in the materials field includes:

- **Materials and complete device fabrication** - encompassing multi-target sputtering systems for thin film fabrication; electron beam and thermal evaporation systems; low-cost solution synthesis of semiconductor thin films; multiple high-temperature annealing furnaces
- **Materials and device characterisation** - including optical and electron (multipurpose FEG scanning electron microscope) microscopy and spectroscopy; atomic force microscopy; secondary ion mass spectroscopy; complete solar cell characterisation; and X-ray diffraction.
- **Manufacturing** - Northumbria typically fabricates thousands of solar cell devices annually for emerging applications in distributed power. Inkjet printing, slot-die coating and photonic curing create Northumbria University Fabrication (NU-FAB) – an open access facility for regional businesses to rapidly prototype energy innovations.
- **Smart materials and surfaces laboratory** - focus on energetics of interactions occurring at the interface between materials such as liquids, solids and gases and the fabrication of novel energy efficiency devices to exploit these interactions. Research within the lab spans super-water repellent surfaces to creasing surfaces and microfluidics.
- **Microwave technology lab** - near-field and far-field antenna measuring systems (including anechoic chamber) and vector network analysers for antenna radiation pattern measurements, medical imaging, security and other industrial imaging requirements.
- **Rapid prototyping room**: computer controlled 3D printers, flatbed precision laser cutters.
- **Nuclear magnetic resonance**: Jeol 400MHz Eclipse NMR Spectrometer.

Find out more

D Newcastle University



Work in the Materials field includes:

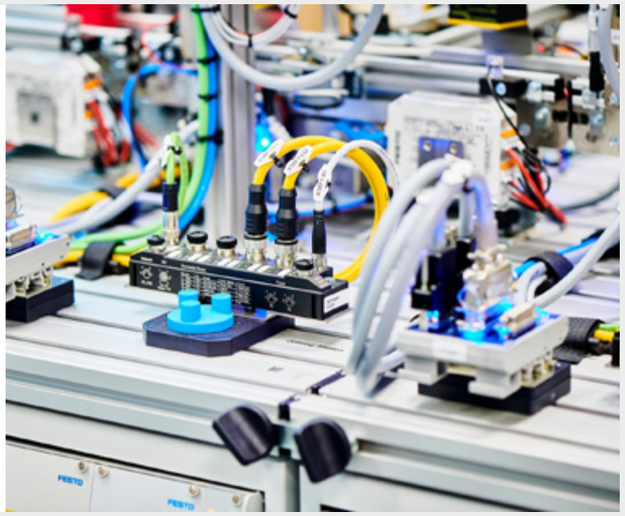
- **Design unit** - gear material, design, analysis and testing.
- **North East Centre for Energy Materials (NECEM)** partner.
- **Hydrogen** - production, combustion, transport, end use, whole systems.

E North East Centre for Energy Materials (NECEM)

The North East Centre for Energy Materials, (NECEM), was formed between the universities of Newcastle, Durham and Northumbria. It unites the expertise present at the three sites to tackle a grand challenge of energy materials and facilities cooperation with local, national and international industry.

- **Newcastle University:**
  - ACMA (including electron microscopy, x-ray powder diffraction, and chemical analysis).
  - NEXUS (including XPS, HIM, SEM, EDX, SIMS, and Raman)
  - NMR Spectroscopy Scanning.
  - Probe Microscopy (including AFM, STM, and SECPM)
  - X-ray Crystallography
- **Durham University:**
  - GJ Russell Electron Microscopy.
  - Microfabrication Cleanroom.
  - Solid State NMR.
- **Northumbria University:**
  - Complete photovoltaic cell fabrication and characterisation.

Find out more



Work with us on North East FEST

Building on our extensive existing asset base and programmes, we are continually developing a programme prospectus for North East FEST, for which we are seeking collaborators, sponsors and funders for projects. Within this prospectus is a range of crucial project opportunities which we have identified and collaboratively developed to tackle our Catalysing Change Challenges.

These opportunities will unlock, at greater pace and scale, the potential of the North East to act as a catalyst region and deliver a Future Energy Systems Today, unlocking global markets for industry, delivering on the UK's decarbonisation goals, and driving the levelling up agenda in the North East.

Get in touch

To find out more, please get in touch.

Andrew Clark
Energy Programme Lead
07775 003 238
northeastlep.co.uk
andrew.clark@nelep.co.uk

David Lynch
Energy Innovation Partnership Manager
07584 154 506
northeastlep.co.uk
david.lynch@nelep.co.uk

Facilitated by

In partnership with

Funded by