

# BIG IDEAS FOR A NET-ZERO FUTURE

A PROPOSAL BY THE  
ENERGY RESEARCH ACCELERATOR, 2021



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# WELCOME

## EXECUTIVE SUMMARY

**The Energy Research Accelerator (ERA), has been delivering energy innovation in the Midlands for the last five years. ERA brings together nine Midlands research intensive organisations and a research community of nearly 1,500 researchers, with a mission to deliver regional impact in energy and interconnected systems.**

With an initial funding of £60m, managed through Innovate UK, within a short space of time, ERA has delivered beyond the original expectation. ERA has created 23 new research facilities, obtained £120m of industrial funding and close to £450m of total value in terms of new investments in energy research and development. This document describes the next phase of activity that ERA plans to deliver – themes that have been co-created with our industrial partners, along with the Manufacturing Technology Centre and the Energy Systems and Connected Places Catapult. ERA has, and through its next phase, will continue to focus on:

- making the UK a scientific superpower, leading in the development of technologies that will support the government's ambition to reach net-zero carbon emissions by 2050
- strengthening the UK's place in the world, making sure the UK does not fall behind other countries in relation to developing solutions to tackle climate change
- levelling up economic opportunity within the Midlands region and beyond by investing in infrastructure, innovation and people, helping to close the gap with the UK's competitors by spreading opportunity
- strengthening the UK's economic recovery from COVID-19 by prioritising jobs and skills

ERA has already helped to create jobs, develop skills and support over 1,000 SMEs. Our next phase has the potential to deliver over £800m GVA 4,400 jobs, plus £1.5bn of leveraged industry funding.

Since 2016, when the ERA programme started, there has been significant progress made in the decarbonisation of the energy system in its broadest terms.

The commitment made by the UK to reach net-zero remains an important national ambition and is crucial to safeguarding the global environment and providing social and economic stability.

However, as every year and decade passes, meeting net-zero becomes ever more challenging. There continues to be a need to accelerate innovation and implementation.

The Energy Research Accelerator has worked to join up fundamental research and development with small and large scale demonstration and deployment with the ability to also manufacture successful solutions.

ERA has shaped regional policy, helping to establish Energy Innovation Zones and encompasses large scale demonstration projects such as the Trent Basin in Nottingham, the hydrogen demonstrator on the Keele Campus, the Tyseley Energy Park in Birmingham and the UK Battery Industrialisation Centre in Warwick.

This ability to drive innovation through the technology readiness levels into real-world, city-level projects is what makes ERA unique and provides the platform for the greater push required towards 2050.

By building on the facilities we have created and our collective expertise, we believe that we can provide significant future economic growth and stimulate the creation of new, high-skilled jobs. This process, called "Big Ideas" has distilled out six major themes and further four cross-cutting activities to maximise the potential of these ideas. These four cross-



Imagine how our Green Industrial Revolution could transform life across our United Kingdom. You cook your breakfast using hydrogen power before getting in your electric car, having charged it overnight from batteries made in the Midlands. Around you the air is cleaner, and the trucks and trains, ships and planes are running on hydrogen or a synthetic fuel. British towns and regions – Teesside, Port Talbot, Merseyside and Mansfield – have become synonymous with green technology and the jobs they bring. This is where Britain's ability to make hydrogen and capture carbon pioneered the decarbonisation of transport, industry and power."

Prime Minister Boris Johnson, The Ten Point Plan for a Green Industrial Revolution, November 2020

cutting themes are focused around assisting policy-making at a regional and national level; supporting SMEs in low carbon sectors; utilising the living labs concept; and developing the skills needed for the net-zero transition.

The "Big Ideas" propose:

- **A National Facility for Energy Storage Scale Up and Demonstration.** This aims to accelerate the development of energy storage through integration into the next generation of energy from waste facilities
- **A National Centre for Decarbonisation of Heat.** This aims to support the delivery of the decarbonisation of heat for the UK housing retrofit sector.
- **Midlands City Scale Digital Twins.** This aims to establish two regional city scale demonstrators of digital twins for energy infrastructure development.
- **The National Centre for Low-Carbon Alternative Fuels.** The aim of this is to produce, utilise and characterise alternative fuels, replacing fossil fuels for road, marine and aviation transport, plus energy production and heating.
- **Midlands Hydrogen Innovation Support Platform.** This aims to create a Midlands-wide hydrogen innovation platform which supports SMEs and original equipment manufacturers to develop and deploy hydrogen technologies associated with heating and transport applications.

■ **Midlands Hydrogen Freight and Public Transport System.** This aims to establish a series of connected programmes to develop a Midlands hydrogen transport system for heavy vehicles from trucks to buses and trains.

This is an ambitious programme that builds on the outstanding ERA track record with a commitment from the ERA partners to deliver. In the year that the eyes of the world will be on our country as we host COP26, the ERA programme offers an opportunity to show that the UK is at the forefront of energy innovation. It is a wide-reaching intervention that will fundamentally change the way that the Midlands exploits energy, and has the potential to deliver £800m of GVA, 4,400 new jobs and £1.5bn of leveraged industry funding.

To date we have indications of support and aligned funding from partners of £1.4bn, which recognises the potential of the proposed ERA-2 investment. With this proposal we are seeking £155m of regional investment to support energy innovation and deployment.

**Professor Martin Freer**  
Director, Energy Research Accelerator

## MIDLANDS STRATEGY

# ALIGNING WITH POLICY AND REGENERATING THE REGION

We have designed a programme which will support the following national and regional policy objectives:

### POST-COVID-19 ECONOMIC GROWTH

**The Midlands Energy Sector supports 30,000 direct jobs and 77,900 jobs in its supply chain. The sector has a high level of specialisation which is six times the national average for the energy sector. This contributes £5bn to the regional economy. The output per working age resident in the Midlands is £698 per annum compared with an average of £472 nationally.**

In total, the sector supports around 162,500 jobs and generates around £14bn to the UK economy through its direct, indirect and induced impacts. In terms of the impact of COVID-19, the West Midlands is predicted to experience the largest GVA decline of any region, at over 9% and the East Midlands is ranked as the most vulnerable part of the UK. Creating regional jobs and regional growth for a sustainable future is one of the overarching objectives of the ERA programme, with key elements being front-loaded. The Midlands Engine has identified low-carbon energy and transport infrastructure as two of the four priority areas for the Midlands. In this proposal we demonstrate how a £155m investment can deliver £800m of GVA, create 4,400 jobs, plus attract £1.5bn of leveraged industry funding.

### HELPING MEET NET-ZERO OBJECTIVES

The programme will support meeting both national and regional net-zero targets. In addition to the national target of achieving net-zero by 2050, a number of cities, such as Nottingham and Birmingham have declared earlier net-zero targets, with the vast majority of the Midlands' emissions

coming from energy and transport use. ERA-2 will undertake R&D, utilising the Midlands as a 'living lab' with solutions that can then be applied across the rest of the UK.

### LEVELLING UP R&D SPEND

The Midlands has been shown to be under-invested in terms of government R&D spend. While investment in R&D by businesses in the East and West Midlands is above the UK average, state support for R&D in the East and West Midlands is well below average. This strongly suggests that increased public spending on R&D could leverage the benefits of private sector support and investment still further. ERA-2 allows investment at scale across the region, utilising an established and successful partnership which will be able to mobilise at speed.

### DELIVERING SCIENCE AND TECHNOLOGY EXPERTISE

This investment will enable the UK to gain global leadership in areas of energy technology, increasing resilience and reducing reliance on energy imports. It will allow us to build on strengths already developed via ERA's initial programme, with the majority of investment being in Technology Readiness Level (TRL) 3-7, making this investment ideal to support the development of commercial solutions in the UK with the potential for use both in the UK and internationally. (See figure 2 on page 11).

### IMPROVING AIR QUALITY

Air quality accounts for 40,000 deaths per year in the UK. Six Air Quality Management Areas are in place or under development in a number of Midlands cities. Our programme will support the uptake of renewable technologies, electric vehicles and hydrogen, which will reduce emissions over the long-term.

# IMPACT

OF THE MIDLANDS ENERGY SECTOR

**30,000** DIRECT JOBS

**77,900** SUPPLY CHAIN JOBS

MIDLANDS LEVEL OF SPECIALISM IS **SIX TIMES** ABOVE THE NATIONAL AVERAGE FOR THE ENERGY SECTOR

THE MIDLANDS ENERGY SECTOR CONTRIBUTES **£5BN** to the regional economy

UK ENERGY SECTOR JOBS SUPPORTED **162,500** CONTRIBUTES **£14BN** to the UK economy

ERA'S BIG IDEAS WILL DELIVER

**£800M** GVA

**4,400** JOBS



INTRODUCING THE

# BIG IDEAS FOR A NET-ZERO FUTURE

“

The UK was the first major economy to embrace a legal obligation to achieve net-zero carbon emissions by 2050. I will establish Task Force Net-Zero to take forward this national priority, and through next year’s COP26 Summit, we will urge countries and companies around the world to join us in delivering net-zero globally.

Prime Minister Boris Johnson, The Ten Point Plan for a Green Industrial Revolution, November 2020

The Energy Research Accelerator’s Big Ideas have been developed by recognising the Midlands’ priorities and needs as set out in the Ten Point Plan for Green Growth in the Midlands Engine. These focus on Green Buildings, Net-Zero Transport, Nature’s Recovery, Blue-Green Places, Low-Carbon Hydrogen, Clean Energy, Smart Energy, Green Innovation, Energy Workforce and Green Finance.

The Big Ideas are also designed to support the successful regional delivery of innovation associated with the UK Government’s Net-Zero

Innovation Portfolio - a £1bn fund, announced in the Prime Minister’s ten-point plan for a green industrial revolution. This Innovation Portfolio is wide ranging and contains stimulus for developments which include bioenergy, hydrogen supply, energy storage, industrial fuel switching and disruptive technologies. For innovation funded through these programmes, a supportive ecosystem also has to be integrated. ERA has worked across the Midlands to develop large scale demonstrator projects and energy innovation zones, convening the right partners to deliver and create the political engagement and understanding to help create an environment which has the maximum potential for success.

## BIG IDEAS FOR THE NET-ZERO AMBITION

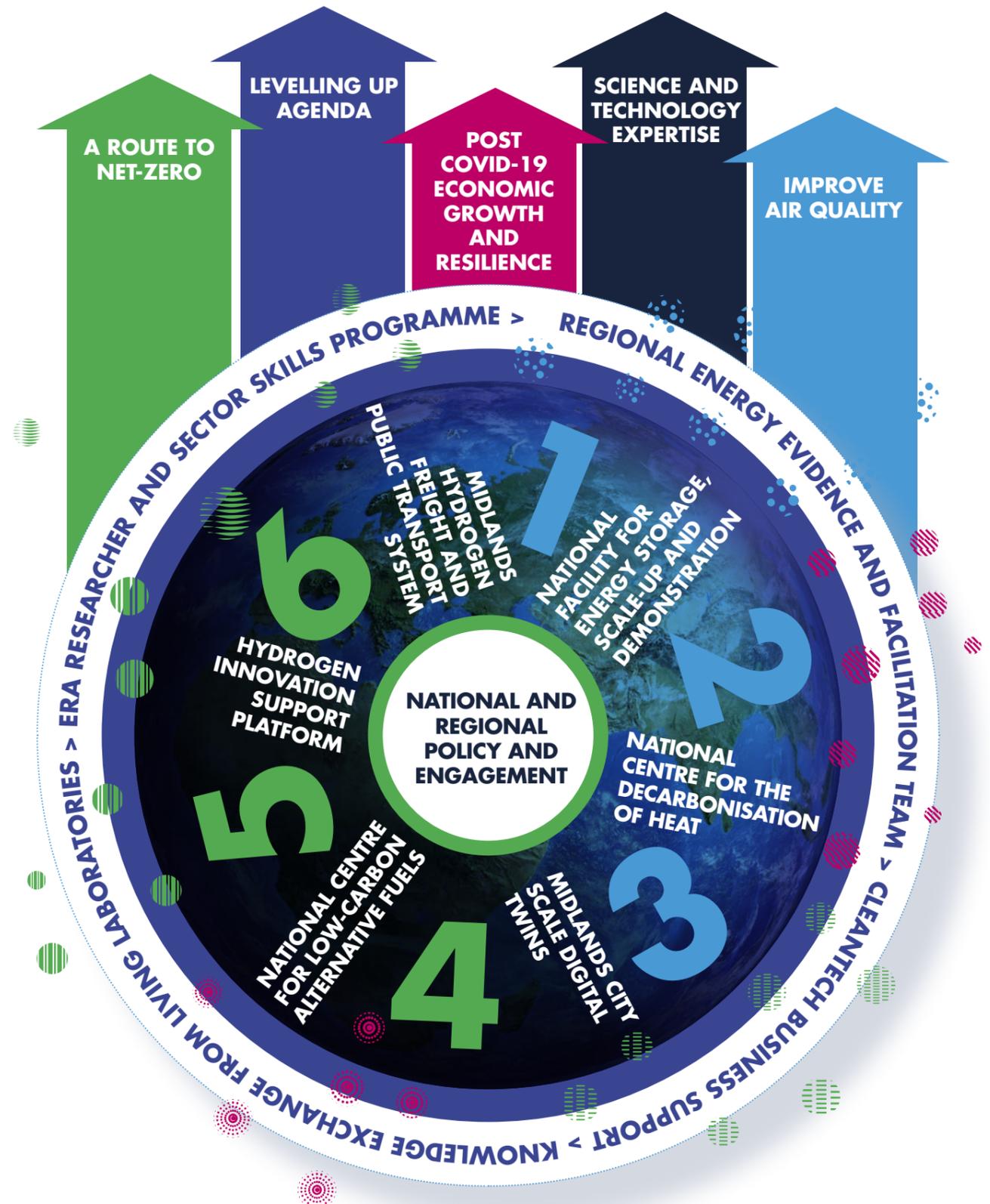


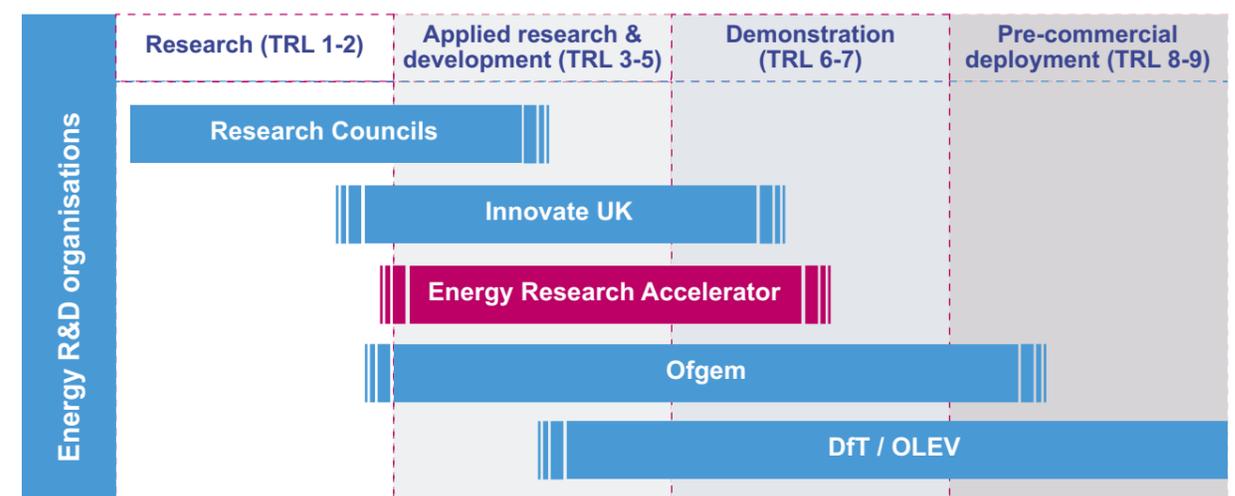
Figure 1: ERA’s Big Ideas for Net-Zero proposal is based on six key research and innovation areas (the spokes of the wheel) and four supporting themes (around the wheel and the centre of the wheel), aimed to jointly target key policy objectives (the arrows).

NO.	BIG IDEA THEME TITLE	SUMMARY OF FOCUS ACTIVITY
1	<b>NATIONAL FACILITY FOR ENERGY STORAGE, SCALE-UP AND DEMONSTRATION</b>	This programme will hot-house an integrated system of thermal and electrical energy storage to accelerate technology development while also developing a deeper understanding of how to integrate a range of storage technologies with energy generation.
2	<b>NATIONAL CENTRE FOR THE DECARBONISATION OF HEAT</b>	Recognising this is the premier challenge for the UK reaching net-zero and that integration of capability and expertise into a single centre is needed to move things forward, ERA and partners have developed a proposal for a national centre in the Midlands.
3	<b>MIDLANDS CITY SCALE DIGITAL TWINS</b>	Digitisation and digital twinning are going to be powerful tools of the development and design of future energy systems. The Energy Research Accelerator will support two pioneering digital twinning programmes in the Midlands with the cities of Birmingham and Nottingham.
4	<b>NATIONAL CENTRE FOR LOW-CARBON ALTERNATIVE FUELS</b>	Building on the Midlands sector strength and the need to support the development and delivery of alternative fuels for road, rail and air transport, a proposal for a National Centre for Low-Carbon Alternative Fuels has been developed.
5	<b>MIDLANDS HYDROGEN INNOVATION SUPPORT PLATFORM</b>	Utilising the significant expertise both in academia and industry and the facilities within the region such as HyDeploy at Keele and Tyseley Energy Park in Birmingham, ERA will develop a hydrogen innovation support platform for businesses associated with hydrogen for heating and transport. This will ensure the Midlands maximises its innovation potential in this key sector.
6	<b>MIDLANDS HYDROGEN FREIGHT AND PUBLIC TRANSPORT SYSTEM</b>	Building on the leading role ERA has taken in developing the pioneering H2GVMids programme, which will establish the foundations for the roll out of 44 tonne hydrogen trucks across the Midlands, ERA will take a leading role in developing the next stages of the programme following on from the feasibility study.

These six thematic areas will be supported by a series of cross cutting themes which will establish the skills base, SME support programmes, policy development and large-scale deployment opportunities through living laboratories. This integrated programme will ensure the skills base of the ERA partnership is optimally deployed in delivering both the UK and Midlands' Ten Point Plans.

CROSS-CUTTING THEME TITLE	SUMMARY OF FOCUS ACTIVITY
<b>1. REGIONAL ENERGY EVIDENCE AND FACILITATION TEAM</b>	To provide support to policy-makers at a local, regional and national scale.
<b>2. CLEANTECH BUSINESS SUPPORT</b>	To support the development of SMEs in low-carbon sectors, delivering exports, sales and sector and jobs growth.
<b>3. KNOWLEDGE EXCHANGE FROM LIVING LABORATORIES</b>	To utilise the living lab concept, building on the existing demonstrators, and sharing our knowledge from this work.
<b>4. ERA RESEARCHER AND SECTOR SKILLS PROGRAMME</b>	To deliver a sustainable pipeline of future energy leaders and knowledge transfer experts who can support the UK's transition to net-zero.

Figure 2: ERA's Technology Readiness Levels typically bridge the crucial 'valley of death' between academic research and commercialisation.

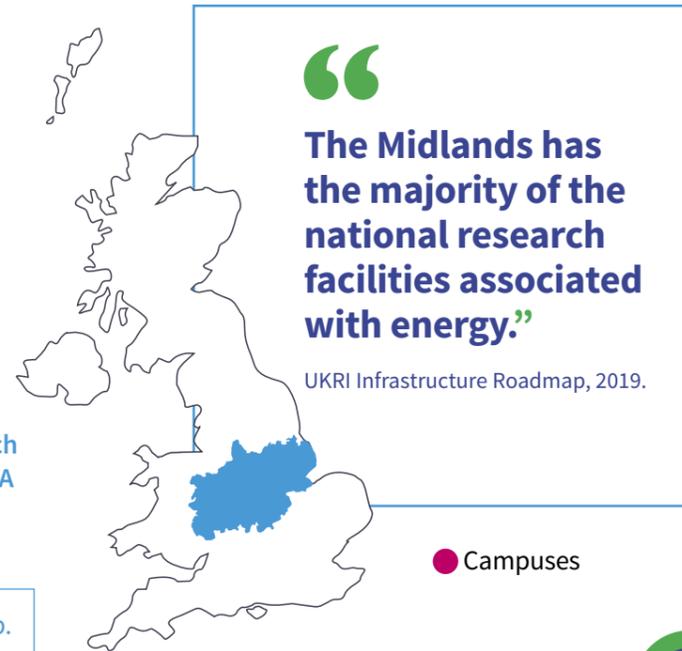


# THE BIG IDEAS PROPOSED MIDLANDS FOCUS

## WHY THE MIDLANDS?

The Midlands is a region which has historically underperformed in terms of employment, skilled jobs and has been significantly impacted by COVID-19, and hence ERA aligns strongly to the levelling-up agenda.

The region is home to around 10,000 companies working in the energy sector, including National Grid, E.ON UK, Engie, Rolls-Royce, Worcester-Bosch plus many promising emerging SMEs, of which ERA has supported over 1,000 within the region.



## MIDLANDS IMPACTS

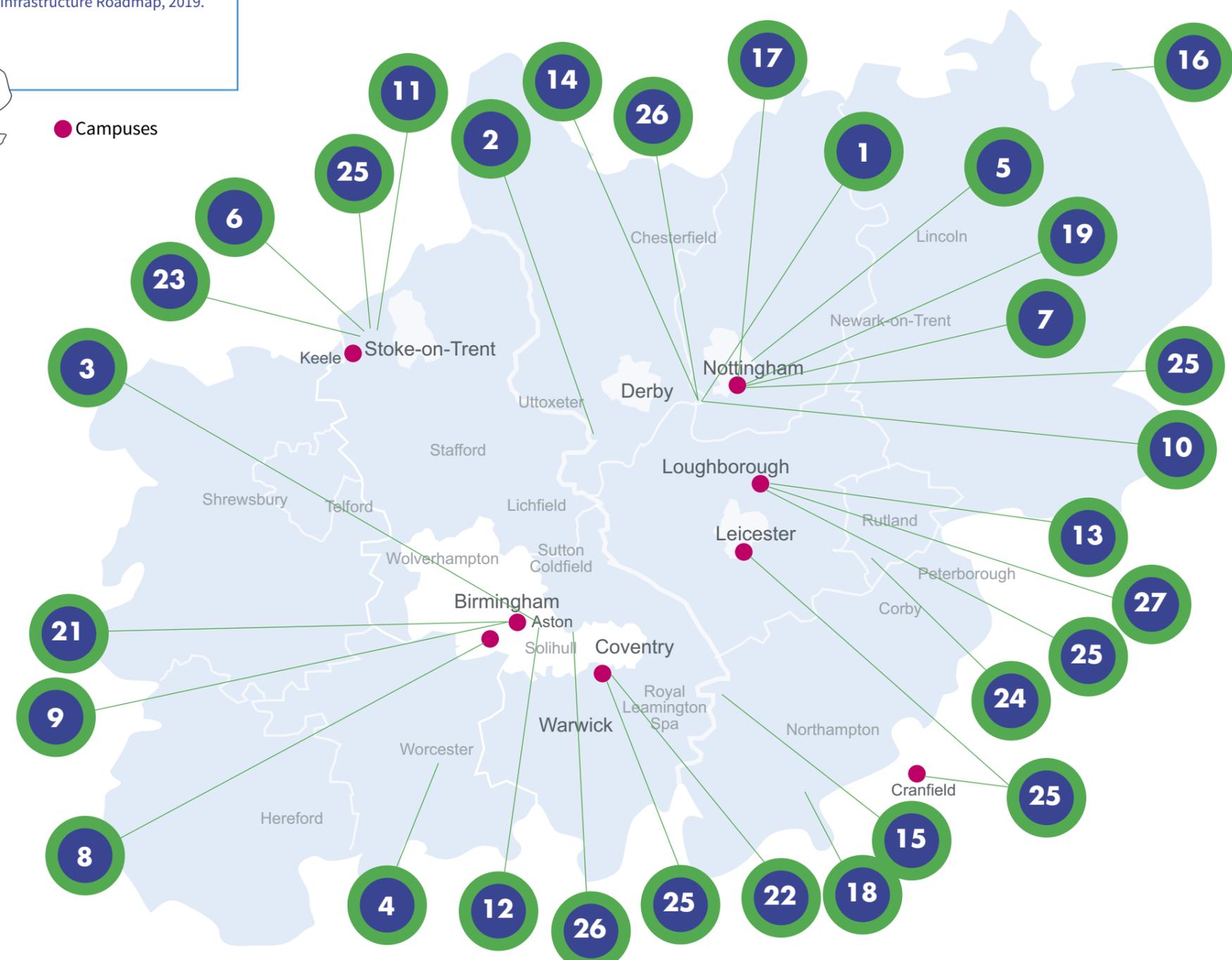
- ▶ **10,000** companies
- ▶ **56,000** regional jobs
- ▶ **£2.5BN+** capital yearly

The Midlands employs around one third of the people in the UK's energy sector with over 56,000 regional jobs. Every year more than £2.5bn of capital investment is made in energy technologies and infrastructure (excluding buildings and transport) across the Midlands.

The Midlands is well placed to be a global leader in energy, creating jobs and wealth for the region's people and businesses, and playing a crucial role in the UK's economic recovery from the COVID-19.

Figure 3: The Big Ideas for Net-Zero coverage map.

1. National Facility for Energy Storage – Ratcliffe Power Stations
2. National Facility for Energy Storage – Drakelow Power Stations
3. National Centre for Decarbonisation of Heat – Tyseley
4. National Centre for Decarbonisation of Heat – Worcester Bosch
5. National Centre for Decarbonisation of Heat – Trent Basin
6. National Centre for Decarbonisation of Heat – Keele
7. Midlands City Scale Digital Twins – Nottingham
8. Midlands City Scale Digital Twins – Birmingham
9. National Centre for Low Carbon Alternative Fuels – Aston
10. National Centre for Low Carbon Alternative Fuels – East Midlands Airport
11. Hydrogen Innovation Support Programme – Keele HyDeploy Demonstrator
12. Hydrogen Innovation Support Programme – Tyseley Energy Park
13. Hydrogen Innovation Support Programme – Loughborough Skills
14. Midlands Hydrogen Freight And Public Transport System – East Midlands Freeport
15. Midlands Hydrogen Freight and Public Transport System – Daventry International Rail Freight Terminal
16. Midlands Hydrogen Freight And Public Transport System – Immingham
17. Regional Energy Evidence and Facilitation Team – Nottingham
18. Cleantech Business Support – Cranfield
19. Cleantech Business Support – Nottingham
20. Cleantech Business Support – Birmingham
21. Cleantech Business Support – Aston
22. Cleantech Business Support – Warwick
23. Cleantech Business Support – Keele
24. Living Lab knowledge exchange – e.g. rural
25. Living Lab knowledge exchange – campuses
26. Living Lab knowledge exchange – Airports
27. Researcher and Sector skills programme – Loughborough



# BIG IDEAS FOR A NET-ZERO FUTURE



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**BIG IDEA****NATIONAL FACILITY FOR ENERGY STORAGE SCALE UP AND DEMONSTRATION**

**AIM: ACCELERATING THE DEVELOPMENT OF ENERGY STORAGE THROUGH INTEGRATION INTO NEXT GENERATION ENERGY FROM WASTE FACILITIES**



Pictured: Highview Liquid Air Energy Storage Facility at the University of Birmingham.

**OVERVIEW****The need for storage**

The government's Ten-Point Plan for a Green Industrial Revolution paves the way to a UK energy system with a very high reliance on renewable energy generation. The decarbonisation of heating and transportation will increasingly rely on the production of green electricity at a scale which could reach

a factor of 2-3 times higher than the present level of electricity generation. There is likely to be some growth in the generation of electricity from the nuclear power sector though the level is uncertain, but the bulk of this additional generation will be delivered by wind and solar. The wind element will come from a growth of off-shore wind, but increasingly on-shore generation. The generation from solar is strongly seasonal in terms of output, and wind is intermittent on shorter time scales. As yet it is not clear what role electricity generation using

gas and carbon capture and storage will be part of the mix, and this uncertainty presents high risk.

At present, the main component of UK heating is generated from combustion of natural gas. Heat demand is highly variable with rapid variations, with the daily variability synchronised with consumer behaviour during the working day and week. At present that very high degree of variability, sometimes a factor of 2 within an hour, is accommodated through having a large amount of storage in the gas pipeline, 26 billion m<sup>3</sup>, where variations in demand are managed through adjusting the gas pressure. For a national heating system in which natural gas is removed there is the need for better management of thermal demand. In order to overcome both the variability in generation and demand there is a need for large scale, tens of gigawatts, medium timescale, energy storage systems.

The two biggest challenges over the next 10-15 years are the space heating and wind power variability. Although a component of the storage can come from electric vehicle batteries, this technology is not well suited to the timescales required, nor the scale of demand, and certainly not appropriate for thermal storage applications. On the electrical side there will be a strong need for technologies such as Compressed Air Energy Storage (CAES), Liquid Air Energy Storage (LAES) and Carnot batteries. The solution on the thermal energy side will almost certainly require significant development of energy storage materials, devices and delivery systems, and thermal management systems and trading mechanisms.

The UK has grown its levels of renewables significantly, but is in the unfortunate position of having low levels of pumped hydro-storage and a limited level of export capacity. The pressures of developing storage solutions fall maximally on the UK, but is an issue globally, as greater levels of renewables are deployed. UK leadership will set the pace internationally.

**Types of storage**

There are many types of storage systems which range from Compressed Air Energy Storage, where air is compressed in a tank or underground cavern and then the pressure is released through a turbine; Liquid Air Energy Storage which uses electricity to liquify air gas and then uses compression and/or waste heat to boil the liquid with the expanding

vapour driving a turbine; batteries of different types, including flow batteries to mechanical flywheels and superconducting magnetic energy systems. Pumped thermal energy storage (PTES) systems are also important developments as several medium duration thermal storage systems rely on this mechanism. On the thermal side there are high temperature systems such as molten salt through to a range of materials, both sensible and phase change, for storing thermal energy down to sub-zero temperatures. Also under development is thermochemical storage technologies suitable for cost-effective large scale long term compact storage. The almost universal character of these energy storage systems is that they need to improve efficiency, reduce cost, scale-up and demonstrate commercial viability.

**OUR PROPOSAL****The National Facility for Energy Storage Scale Up and Demonstration**

To meet the national need, it will be necessary to hot-house the development of energy storage. This would support the development and demonstration of the range of energy storage technologies being supported through the BEIS "Longer Duration Energy Storage Demonstration competition". What is required for an acceleration programme is the right expertise to support the development and the right infrastructure and facilities. An ideal location for such a facility is an old, coal, power station site with the development of an Energy from Waste facility providing access to electricity and heat. The East Midlands has a number of such sites with GW electrical connections to the national electricity grid and planned Energy from Waste plants which will generate 20+ MW of electricity and up to a factor of 3 to 4 this amount of heat energy. There is also potential for hydrogen production at such sites. This energy infrastructure provides the ideal location for testing and developing energy storage technologies. Stored electricity will provide an opportunity for the electricity generated by the Energy from Waste plant to be delivered flexibly into the grid to match demand and to take advantage of the variability of electricity prices. The thermal storage facilities can be integrated into any local housing development or utilised for businesses clustering around the plant.

Through the Energy Research Accelerator the Midlands has some of the leading international

expertise associated with energy storage. It coordinates energy storage activities through the Engineering and Physical Sciences Research Council's Supergen Storage Network Plus 2019, it also hosts the Manifest project which is a network of national energy storage facilities. The universities have supported the development of some large scale energy storage technologies including LAES through Highview Power who are now scaling LAES to 250 MWh capacity. Working with partners in China, the University of Birmingham has also developed a technology which delivers 1.5 GWh of thermal energy storage by capturing curtailed wind power, and they are now working on next generation of energy storage integrated into wind generation.

### THE IMPACT

The National Facility for Energy Storage Scale Up and Demonstration would integrate the academic expertise and early stage R&D with the scale-up and demonstration facilities. The site would be the host for technology developers to accelerate and demonstrate their storage technologies working with the academic base but also in collaboration with major energy companies as a stepping stone

to commercial deployment. A key component of the facility would be the integration of a range of thermal and electrical storage systems, with a range of characteristic storage timescales and response times. A key output would be to understand the optimal energy storage system based on a range of technologies, and the interaction of the different components. The facility would create:

- a cluster for businesses developing energy storage systems and energy technologies and a launchpad for businesses to commercialise technologies
- facility for manufacturing energy storage systems and materials
- next generation energy services on-site as part of the EfW plant, greater flexibility of electricity and energy delivery and potential to maximise the commercial return on the EfW development
- flexible low cost energy generation of electricity and heat to cluster low-carbon business
- energy systems and low-carbon energy skills and training

Pictured: Developments at Highview Power.



# 2

## BIG IDEA

# NATIONAL CENTRE FOR THE DECARBONISATION OF HEAT

**AIM: SUPPORTING THE DELIVERY OF THE DECARBONISATION OF HEAT FOR THE UK HOUSING RETROFIT SECTOR**



Pictured: Artists impression of the new National Centre for the Decarbonisation of Heat.

### OVERVIEW

#### The need for low-carbon heating

The decarbonisation of heat is the major energy challenge that will impact nearly every UK home. For the Midlands, this presents a major opportunity to enable economic recovery with the majority of UK boiler manufacturers being based in the region. A National Centre for the Decarbonisation of Heat (NCDH), will enable the rapid scaling-up of manufacturing, skills and deployment of heat solutions – all necessary to meet carbon

reduction targets. The cost of delivering the low-carbon heating transition is expected to reach £15bn per year and will require major investment into energy generation and the grid infrastructure. There is a need to drive down costs and accelerate deployment and innovation. The scale mirrors that of the Offshore Wind sector, which delivered a sectorial transition by recognising that a scale-up and cost reduction programme required the co-ordination of standards development, supply chains, planning, scaling of manufacturing and working with businesses to enable them to transition into the sector. The strategic direction for low-carbon

heating - heat pumps, hydrogen, biomass, biogas, district heating – is not yet fully defined and will emerge through the national heat policy. However, whichever technology, or mix of technologies, eventually dominates, all face the challenge of scaling-up, manufacturing capacity, supply chains and a skilled workforce. These are the challenges the NCDH will help to solve. The economic benefits to UK jobs and manufacturing will be enormous for a sector which is likely to see net spend reach several hundred billion pounds.

The Midlands is known for its excellence in academic research in thermal energy technologies, ranging from the development of heat pumps at Warwick, biofuels at Aston, the hydrogen for heat (HyDeploy) project at Keele, the creation of new energy storage technologies at Birmingham, through to the excellence in the development of the built environment at Loughborough and Nottingham. It is also the base for many of the companies that will deliver future heat solutions; Worcester-Bosch, Baxi, Vaillant, E.on, National Grid and Engie.

Figure 4: Diagram of outputs for the National Centre for the Decarbonisation of Heat.



## OUR PROPOSAL

### The National Centre for the Decarbonisation of Heat

The NCDH would be driven by a consortium of the ERA academic institutions, the Energy Systems Catapult, the Manufacturing Technology Centre, business, green finance consumer groups and standards associations. The aim would be to create consensus in the heat sector, develop a coherent delivery plan, work with local government in the region and beyond to develop and deliver solutions and to establish and coordinate a number of regional heat delivery pilot schemes ('living labs'). To drive the development of the heat sector the NCDH will create the following capabilities:

- Manufacturing acceleration
- Heat skills academy
- Business support and innovation accelerator
- Building integration test facility and a community-based living pilot schemes and living-lab
- Standards and verification facilities
- Green finance support and pilots

The NCDCH would be built on the Tyseley Energy Park, creating 5,000 square metres of space for scale-up development, skills and training, plus standards and verification laboratories and a business incubation centre with innovation support. This would be linked to physical demonstrators (living labs) which are already developed in the adjacent East Birmingham communities, which has a below average energy efficiency housing stock and also the Trent Basin Demonstrator in Nottingham, and the Keele campus demonstrator in Staffordshire. It will link into the developments associated with the regional Energy Innovation Zones and projects such as the Peterborough City Council PIRI project through Cranfield University.

## THE IMPACT

The new National Centre for Decarbonisation of Heat will establish:

- **A Centre for the Decarbonisation of Heat** – a new building to co-locate the interdisciplinary consortium and core activities of the NCDH, capital for innovation and training, a NCDH core operations budget and a Finance Development Programme.
- **Digital Manufacturing Accelerator / Standards and Verification** – would work with coordinating standards organisations such as BSI, BEAMA and IEEE to develop the right standards and verification structures and work with the heat technologies manufacturing sector to support rapid scale-up and fast deployment of heating solutions.
- **Heat Skills Academy** – will coordinate and train existing and new heating engineers in heat pumps, hydrogen boilers, smart system controls, digital platforms, building integration and surveying, building performance assessment and monitoring.
- **Building Integration and Living Laboratory** – would deliver consumer-centric trials in real-world, digitally-enabled homes, helping to overcome fuel poverty, building upon expertise in consumer insights, systems integration and local area planning. The Living Lab would become a national asset for home energy

innovation with consumers at the heart, helping innovative businesses to rapidly design, market test and launch smart energy products and services. This will provide capability to test new products, services, business models and new green finance solutions in real homes with digital and data infrastructure installed for representative market conditions. The Living Lab will also enable real-world feedback of energy innovations, market arrangements, policy and regulations – as we move towards a net-zero carbon future.

- **Business Support and Innovation Accelerator** – the NCDH will help demonstrate prototypes and get to market quickly. This will enable SME innovators to bring their products to market in time to help achieve climate targets.
- **Expertise and support around green finance** – the programme will be a key partner with Green Finance Institute.
- **The NCDH will utilise the Trent Basin facility developed through ERA** – this living lab, located in Nottingham, creates additional reach across the Midlands region and comprises fully-instrumented homes within multi-vector (heat and power) energy systems. This would enable real-world testing and optimisation of electrification of heat by utilising existing fourth generation low-temperature heat networks, micro-smart grids, electricity and thermal stores and multiple forms of renewable energy generation. More importantly, the facilities have an operational supervisory control and data acquisition system (SCADA) to enable the optimisation of energy generation, storage and use, to mitigate low-voltage network grid constraints - one of the biggest technical barriers to moving heating onto the electricity network.

Though of national reach, the NCDH would work with the Midlands Energy Hub to provide LEPs, Local Authorities and City Councils across the Midlands with the advice and guidance required to deliver regional and local heat solutions. In addition, some of the research facilities already created by ERA will be used to support the development, innovation and deployment programme.

# 3

## BIG IDEA

# MIDLANDS CITY SCALE DIGITAL TWINS

**AIM: TO ESTABLISH TWO REGIONAL CITY SCALE DEMONSTRATORS OF DIGITAL TWINS FOR ENERGY INFRASTRUCTURE DEVELOPMENT**



Pictured: Trent Basin 250 acre site uses the SCADA system for energy optimisation.

## OVERVIEW

### The need for digital twinning

There is an annual investment of approximately £12 billion per annum into the UK's energy system. However, as our energy system develops to meet net-zero by 2050, there are significant challenges around the operation, protection and control of the UK's energy supply system on a real-time basis. The key to this transition is having the tools that allow intelligent and informed decision making. At the heart of this is simulation, data, visualisation of complex data and digital tools such as 'digital twinning'.

Internationally, there have been a few examples of pioneering development of city scale digital twins. The City of Helsinki developed the Helsinki 3D+ initiative, which used a combination of laser scanning and oblique photogrammetry to acquire data and images for the project. A reality mesh model of the entire city was developed which acted as the collaborative interface to embed data and management of systems across the city. These are powerful ways of realising the operation of the living space of a city and capturing real time data into a model which allows optimisation of infrastructure and planning. A digital twin allows planners to explore "what if" scenarios linked to the energy and transport infrastructure, modelling everything from

pinch points in energy and transport infrastructure to emissions. There is enormous power and potential, but such systems sit at the early stages, and stepwise development and piloting is required to make them a feature of modern city and urban development.

Increasingly, we are able to extract data from infrastructure and assets in the built environment and define new insight and business models using the data connectivity of the 'Internet of Things' (IoT). Whether this is data streamed in real time or an upload of historic data, the input can be optimised and visualised for the user to create new insight.

## OUR PROPOSAL

### Birmingham and Nottingham digital twins

This proposal is the development of digital representations of the two major regional cities of Birmingham and Nottingham. Working with the City Councils and industrial partners, the aim is to apply the tools and learning to the creation of digital twins of the energy, transport and resource flows. This will build on the expertise of Keele University and the digital twin work they have undertaken with Siemens and Engie, to develop a small town size, multi-vector digital twin on their campus through the Smart Energy Network Demonstrator, SEND, programme. The programme also builds on the Regional Energy System Operator (RESO) project, where ERA academics analysed the energy system of Coventry to explore the advantages of a new kind of energy system operating at a city scale. The Nottingham Trent Basin development is a prime example of how use of data can optimise the energy system associated with smart control. The 500 home housing development on the 250 acre site contains an operational supervisory control and data acquisition system (SCADA) to enable the optimisation of energy generation, storage and use, to mitigate low-voltage network grid constraints.

The present proposal is to develop digital twin programmes for two major cities of the Midlands.

### East Birmingham

East Birmingham is home to more than 230,000 people and forms a crucial part of the City of Birmingham and region's economy. Major growth is anticipated which will deliver more than 60,000

new jobs and 10,000 homes within and near to East Birmingham over the next ten years. With the coming of HS2 and the proposed Midland Metro East Birmingham to Solihull extension, East Birmingham has significant development opportunities. It is a young place where a third of residents are under 16 years old - one of the highest proportions of children in the country. To support the region's development, Birmingham City Council has created the East Birmingham Inclusive Growth Strategy.

A key element of that inclusive growth will be the delivery of the net-zero transition and the most challenging element will be the delivery of energy efficient homes and low-carbon heating. For many of the citizens of that part of the city there are multiple levels of deprivation and high levels of unemployment. For example, the claimant rate in the Birmingham Hodge Hill constituency is 14.1%, roughly one in seven, the highest rate of any constituency in the UK. As of February 2021, there were 11,045 people searching for a job in Hodge Hill.

East Birmingham has many assets that can be drawn upon. Tyseley Energy Park and the Tyseley Environmental Enterprise District is set in East Birmingham, midway between the city centre and the airport. It has presently ~35 MW of electricity generation (including the city energy from waste plant) which is to be scaled up to 60 MW, with potential for capturing the waste heat from these plants into district heating, and plans to scale up hydrogen production to feed into the East Birmingham developments for low carbon heat and transport. Most of the energy production of Birmingham lies within the Tyseley Environmental Enterprise District (TEED), or at the biogas injection being performed at the Severn Trent Minworth site adjacent to Castle Vale.



**A key element of that inclusive growth will be the delivery of the net-zero transition and the most challenging element will be the delivery of energy efficient homes and low-carbon heating."**

A first phase development of a Digital Twin has been funded through the UK government's Community Renewal Fund. This would perform the data mapping work which is the prelude to the creation of the digital twin. The present development would fund the full-scale digital twin.

### Nottingham, Airport and Freeport

The development of residential and commercial construction across the Freeport area and at the three key East Midlands Development Corporation, EMDC, sites of Ratcliffe-on-Soar power station, East Midlands Airport and Toton & Chetwynd present a distinctive opportunity to develop new energy infrastructure. It will also create manufacturing and installer capability to energy retrofit existing buildings.

The multiple, large scale, physical development opportunities that the East Midlands holds provide enabling elements for the transformation of the Midlands economy. The sites are located in the heart of the UK with unrivalled transport connectivity (road, rail and air) and infrastructure links such as the high voltage electrical connection/ capacity and river crossing that will facilitate the proposed energy system. The Freeport opportunity is significant in terms of the manufacturing operations proposed. The proposition is ideally placed to support and feed into some of the most ambitious net-zero carbon city wide strategies such as Nottingham's carbon neutral 2028 objective.

The development will create a fully integrated zero carbon energy system across the three sites in order to improve operational efficiencies and reduce cost through the scale of implementation. The different building functions and typologies will ensure energy demand diversity which significantly

helps with the efficient operation of a smart local multi-vector energy system. The low carbon energy supply will include the proposed low carbon energy generation at Ratcliffe-on-Soar, solar photovoltaic panels on the built infrastructure, and local energy storage which links into the facilities and expertise proposed for the energy storage research and demonstration facilities. If heat generation is an option for Ratcliffe-on-Soar then a fourth generation low temperature heat network could form the backbone of heat provision across the three sites. The location also benefits from proximity to the existing rail corridor and river crossing that could facilitate such a heat network scheme. The developments will utilise widescale vehicle-to-grid EV charging infrastructure to create electrical storage capacity on the local area grids (all new homes, commercial buildings and airport carparking). The optimisation of local energy generation, storage and use on the smart energy networks (heat and power) will create new IP in AI and machine learning, and demonstrate a fully operational zero carbon local energy system. The development will also create and demonstrate new community energy business models that help reduce fuel bills and carbon emissions as well as delivering additional local and national energy resilience and security.

### THE IMPACT

The digital twins of Nottingham and Birmingham will enable us to improve our understanding of electricity and energy systems, providing the means to plan and predict, and improving decision making at both a regional and national level.

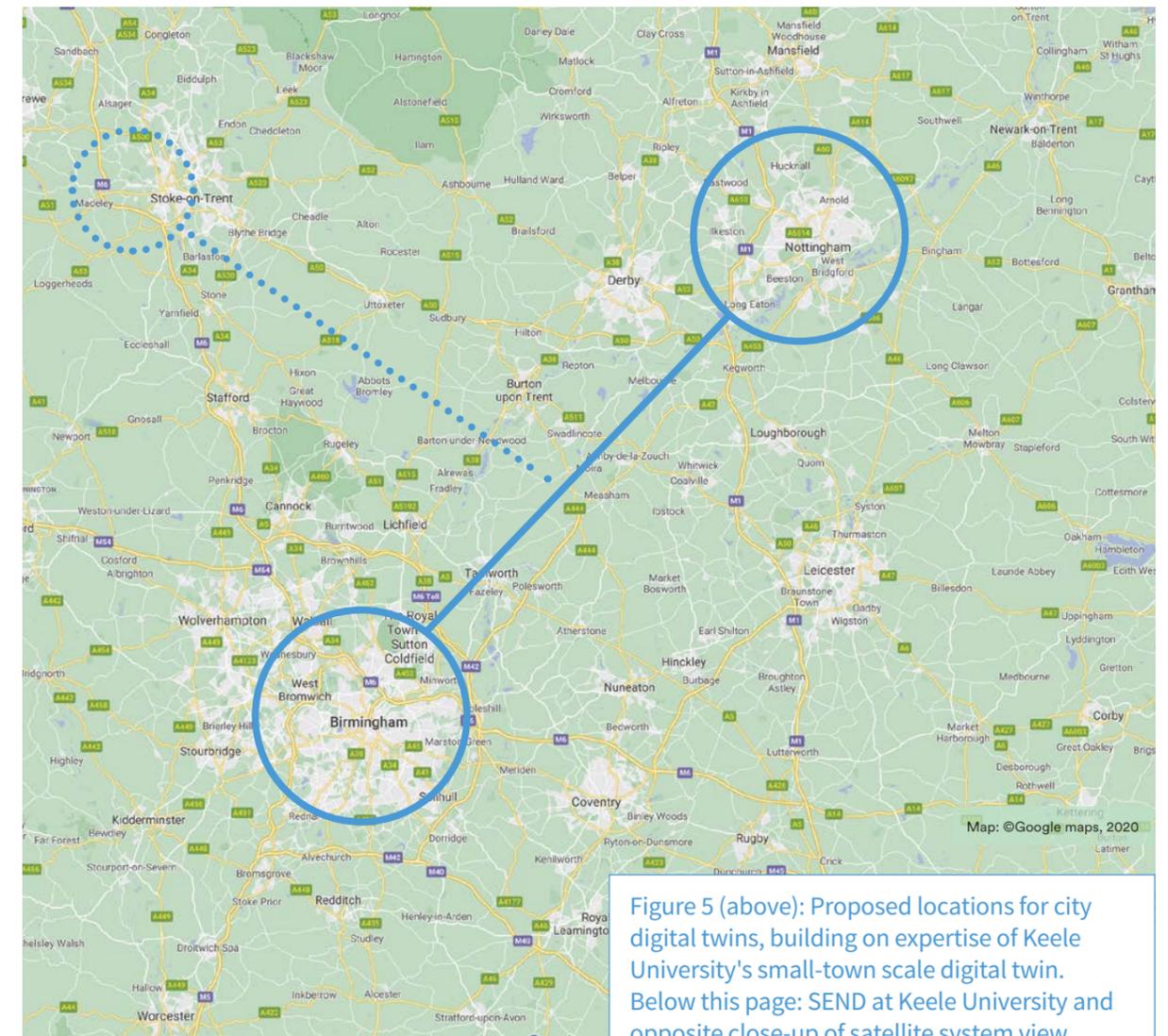


Figure 5 (above): Proposed locations for city digital twins, building on expertise of Keele University's small-town scale digital twin. Below this page: SEND at Keele University and opposite close-up of satellite system view.



# 4

## BIG IDEA

# NATIONAL CENTRE FOR LOW-CARBON ALTERNATIVE FUELS

**AIM: TO PRODUCE, UTILISE AND CHARACTERISE ALTERNATIVE FUELS, REPLACING FOSSIL FUELS FOR ROAD, MARINE AND AVIATION TRANSPORT PLUS ENERGY PRODUCTION AND HEATING**



Pictured: The aviation sector will be one of many to benefit from this new national centre.

## OVERVIEW

The UK's transport, heating and industrial sectors depend on access to high energy-density liquid and gaseous fuels. These are embedded into our existing energy infrastructure, yet incur significant greenhouse gas emissions. As decarbonisation of electricity has accelerated, the relative proportion of climate impacts related to heating, transport and manufacturing has increased. Therefore the synthesis and adoption of low-carbon fuels is vital in delivering early carbon reductions

on our trajectory to net-zero. There are two key elements of the proposed programme, the first is the better understanding of the production and characterisation of the quality of synthetic fuels crystallised into a National Centre for Low-Carbon Alternative Fuels, and the second is examining alternative, low-carbon, techniques for large-scale production of fuels.

The Midlands Engine Regional Energy Hub 2021 report on the "Low Carbon Environmental Goods and Services Market", suggests that alternative fuels accounts for

£3.8bn in the regional economy. This makes it one of the largest components of the regional low carbon economy. The alternative fuels comprise the production, supply and distribution of Natural Gas (Compressed or Liquefied), Synthetic Fuel and Auto Gas (LPG, LP Gas or Propane). This sector includes R&D, alternative fuel providers, designers and consultancy, process implementation, sales and accounting and application development specialists. There has been strong sectorial growth of 11.4% compared with the UK average of 5.7%.

## OUR PROPOSAL

### National Centre for Low-Carbon Alternative Fuels

The synthesis and adoption of low-carbon fuels is vital. However, standards and regulations apply to many sectors that have been built up over many years to protect downstream equipment, maximising performance, availability and minimising outage time. It is critical for near-term drop-in solutions that the low-carbon alternatives are demonstrated to meet the appropriate specifications and that investigations are carried out on the actual impact and consequences of excursions of contaminants or alternative specifications. It is equally important that we confirm the actual carbon reductions being delivered by different alternative heating and transport fuels, what variables will impact on these and what information is needed to support robust regulation of new low-carbon fuels that will ensure wider environmental benefits.

ERA institutions have state-of-the art measurement and characterisation facilities for liquid and gaseous fuels that are currently used in several UKRI and European-funded research projects. However, these generally focus on testing of small volumes of fuels for specific analytical purposes. The National Centre for Low-Carbon Alternative Fuels would build upon this expertise and scale-up fuel testing activities to provide a comprehensive suite of characterisation and analytical facilities that could be used by researchers, fuel developers and commercial users to test the physical and chemical properties of alternative fuels on a contract basis for a variety of users to national and international standards, as well as more bespoke analysis as part of major research programmes.

Critically this analysis would be coupled with the ability to assess the supply chain impact and 'carbon footprint' of the fuels. Aston University has world-leading expertise in life-cycle assessment through the Energy and Bioproducts Research Institute, while the University of Nottingham brings expertise on policy and governance, while the University of Birmingham has specialisation in the development of 'green' hydrogen and both synthetic natural gas and liquified synthetic natural gas. The partnership is developing fuels for a number of different sectors, e.g. aviation fuels through the EU funded FlexJet project.



**Aston University has world-leading expertise in life-cycle assessment through the Energy and Bioproducts Research Institute, while the University of Nottingham brings expertise on policy and governance, while the University of Birmingham has specialisation in the development of 'green' hydrogen and both synthetic natural gas and liquified synthetic natural gas."**

## THE IMPACT

The Low Carbon Alternative Fuels centre would provide life-cycle assessment services to different regulatory standards e.g. REDII or RTFO. It would also work with companies and developers to support achievement of corporate targets around environmental and social responsibility. The Centre would do this by working with fuel developers to identify key hotspots, giving rise to significant environmental impacts in fuel synthesis chains at an early stage; facilitating consideration of alternative feedstocks, process conditions and pathways to minimise environmental impacts. The Centre would provide analysis of environmental trade-offs across different environmental impact categories to support informed decision making where for instance, reductions in carbon emissions might be achieved at the expense of increases in acidification or eutrophication.

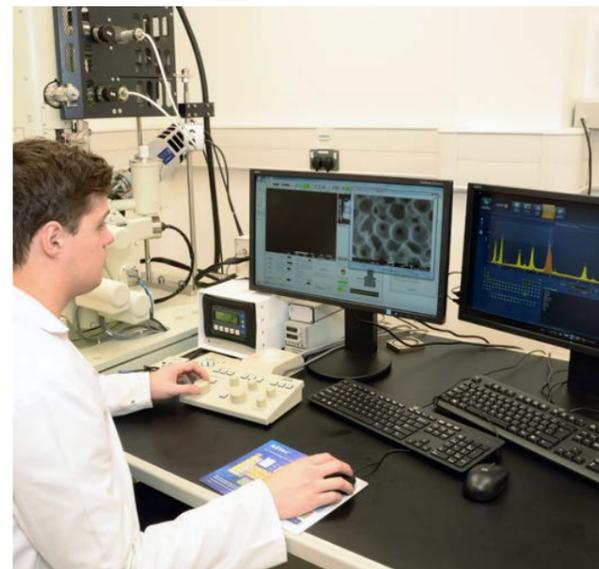
The Centre would particularly focus on sustainable fuels for transport, with a focus on the aviation and marine sectors, as well as kerosene, methane, and propane substitutes for heating, including BioLPG. A key feature will be bringing academic expertise together with industrial deployment knowledge to support policy makers in defining appropriate targets and regulatory frameworks for future sustainable development.

The National Centre for Low-Carbon Alternative Fuels would provide:

- analysis of process synthesis pathways for low-carbon liquids and gases
- testing and characterisation of batches of low-carbon fuels against existing standards/specifications

- evaluation of the reliability, availability and maintainability impacts of low-carbon fuels on conversion plant
- environmental life-cycle assessment of new fuels

The National Centre for Low-Carbon Alternative Fuels would initially establish itself as a distributed centre accessing key existing facilities at different Midlands universities, with an integrated management and co-ordination function. It would procure investment in new dedicated facilities for fuel characterisation at a site for strategic development of fuels in the Midlands. There are significant opportunities in embedding activities within the East Midlands Freeport and Development Corporation programmes.



# 5

## BIG IDEA

# MIDLANDS HYDROGEN INNOVATION SUPPORT PLATFORM

**AIM: TO CREATE A MIDLANDS-WIDE HYDROGEN INNOVATION PLATFORM THAT SUPPORTS SMES AND MANUFACTURERS TO DEVELOP AND DEPLOY HYDROGEN TECHNOLOGIES ASSOCIATED WITH HEATING AND TRANSPORT APPLICATIONS**



Pictured: Hydrogen test network at Keele University. Photo courtesy of Progressive Energy and the HyDeploy project.

## OVERVIEW

### The need for hydrogen

Globally, hydrogen has become the hottest topic in terms of low-carbon energy, with the potential to simultaneously decarbonise both heating and transport. Hydrogen is set to be a crucial vector in rapidly reducing the UK's emissions across a wide range of industrial processes. The international Hydrogen Council suggests that by 2050 the establishment of a worldwide hydrogen economy would create

a US\$2.5 trillion market for hydrogen and fuel cell equipment and provide sustainable employment for more than 30 million people. Germany has announced a \$9 billion hydrogen investment programme, Japan has set the target to have a complete hydrogen society by 2050, and countries such as China, South Korea and Australia have major ambitions association with hydrogen-based technology.

The UK has established a Hydrogen Advisory Council that is to inform the development of hydrogen as a strategic decarbonised energy carrier. This is amplified by the Ten Point Plan

for Net Zero which includes “Hydrogen: Working with industry aiming to generate 5GW of low carbon hydrogen production capacity by 2030 for industry, transport, power and homes, and aiming to develop the first town heated entirely by hydrogen by the end of the decade.”

## Why the Midlands?

The Midlands is a key location of commercial innovation associated with hydrogen. It has companies such as Worcester-Bosch, Baxi and Cadent (hydrogen boilers and gas networks), Intelligent Energy (fuel cells), Porterbrook (hydrogen trains), Toyota (hydrogen vehicles), Caterpillar, Faun Zoeller and JCB (heavy vehicles), DVNGL, BSI, Cenex, Engie and Cadent (Hydrogen Networks), Progressive Energy, and close by ITM Power and ITM Motive (hydrogen generation and transport respectively). Siemens and Engie are also working closely with regional partners in next generation hydrogen production and storage. The Midlands is home to cutting edge research and development on hydrogen, with universities, bound together through the Energy Research Accelerator (ERA).

ERA is leading in next-generation hydrogen technologies and ERA institutions have been pioneers in hydrogen in the gas network (Keele), hydrogen transport (Birmingham), hydrogen production from natural gas (Loughborough), hydrogen production (Cranfield, Warwick and Aston) and hydrogen storage (Nottingham). Furthermore, the ERA partners host the national and EU Funded training programmes associated with doctoral level training for hydrogen combustion (Keele) and fuel cells (Nottingham, Loughborough, Birmingham).

## OUR PROPOSAL

### A Midlands Hydrogen Innovation Support Platform

A Midlands Hydrogen Innovation Support Platform is proposed in order to support and foster the creation of a new hydrogen industrial economy in the Midlands. This will be achieved by working with SMEs, established Midlands-based and UK commercial partners, and multinationals to accelerate innovation, build markets and support the required skills transition. This will create a

platform in which the eight university partners associated with the Midlands-based Energy Research Accelerator, ERA, will make available their hydrogen facilities, research capability and expertise, and large-scale hydrogen demonstrators that they have developed.

The partners will work with businesses to allow them to accelerate the development of new hydrogen products, transition from declining industrial sectors, train and re-skill, demonstrate the viability of new products, and – by working with local government and local authorities – support the creation of a market for low-carbon hydrogen solutions as part of the net-zero transition. Moreover, the ERA universities will use their international connections to link businesses with growing international markets in countries such as China, UAE, Australia and South Korea to build commercial opportunities that reach beyond the Midlands and the UK.

The programme has been designed to address a market failure and challenge: **How do you rapidly build a new business, industrial and manufacturing sector when very little exists already?** To be successful a business needs to have a supply chain developed, a market for their product and the skilled workforce to be able to develop and deliver the product. The conundrum is that the supply chain will not develop until the volumes of product exist. The market will be slow to evolve because customers are nervous of new to market solutions and for new sectors the training does not exist in the volumes required. The solution is that active support is required in all elements simultaneously, rather than a slow and uncoordinated approach. This coordination maximises the potential of success and de-risks the development for those involved, and makes it a more attractive proposition for external investment.

## THE IMPACT

Midlands Hydrogen Innovation Support Platform builds a powerful consortium of all of the Midlands major academic institutions, combined with businesses associated with hydrogen development, and strengthened by the strong political support of the Midlands Engine and LEPs. It aligns £117m of capability, facilities and demonstrators, and is seeking funding to create the support programme that will allow this capability to be deployed. Hydrogen is a rapidly emerging sector, but there is

Figure 6: Logic Model for the Midlands Hydrogen Innovation Support Platform programme.



no established support structure for businesses. In careful consultation with partners, a series of linked interventions has been devised that will give businesses the greatest opportunity to draw on the ERA support capability and facilities. These are:

- Support for technology development and R&D – using ERA’s research facilities and world-leading expertise
- Support for IP development and commercialisation – using specialist capability of the MICRA programme
- Access to large scale demonstrator and test facilities to validate and showcase technology solutions

- Development of hydrogen skills and expertise in businesses – the skills at the required scale don’t presently exist
- Civic engagement and policy activities to build local government understanding of hydrogen’s role in net-zero
- Development of pathways and an associated support programme to allow businesses to access international markets

Success will see an ecosystem of businesses developing hydrogen products deployed into the Midlands energy and transport system, with the creation of hundreds of new jobs. The Support Platform would link hydrogen development in both the East and West Midlands.

Pictured: Photo shows electrolyser for producing hydrogen at ERA’s Research Acceleration and Demonstration Building.

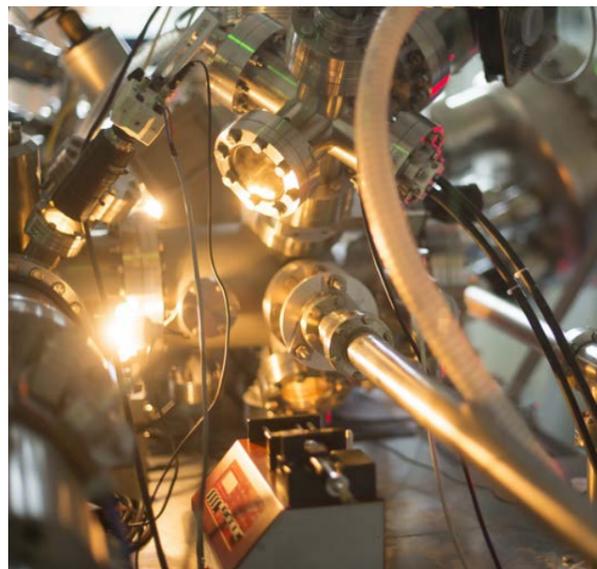
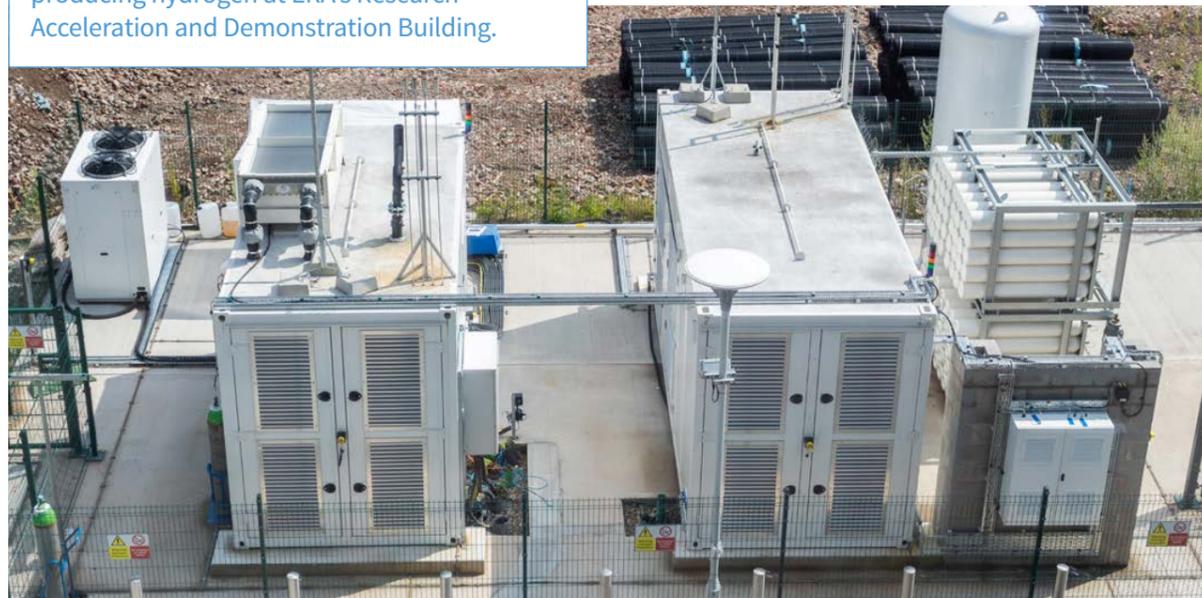
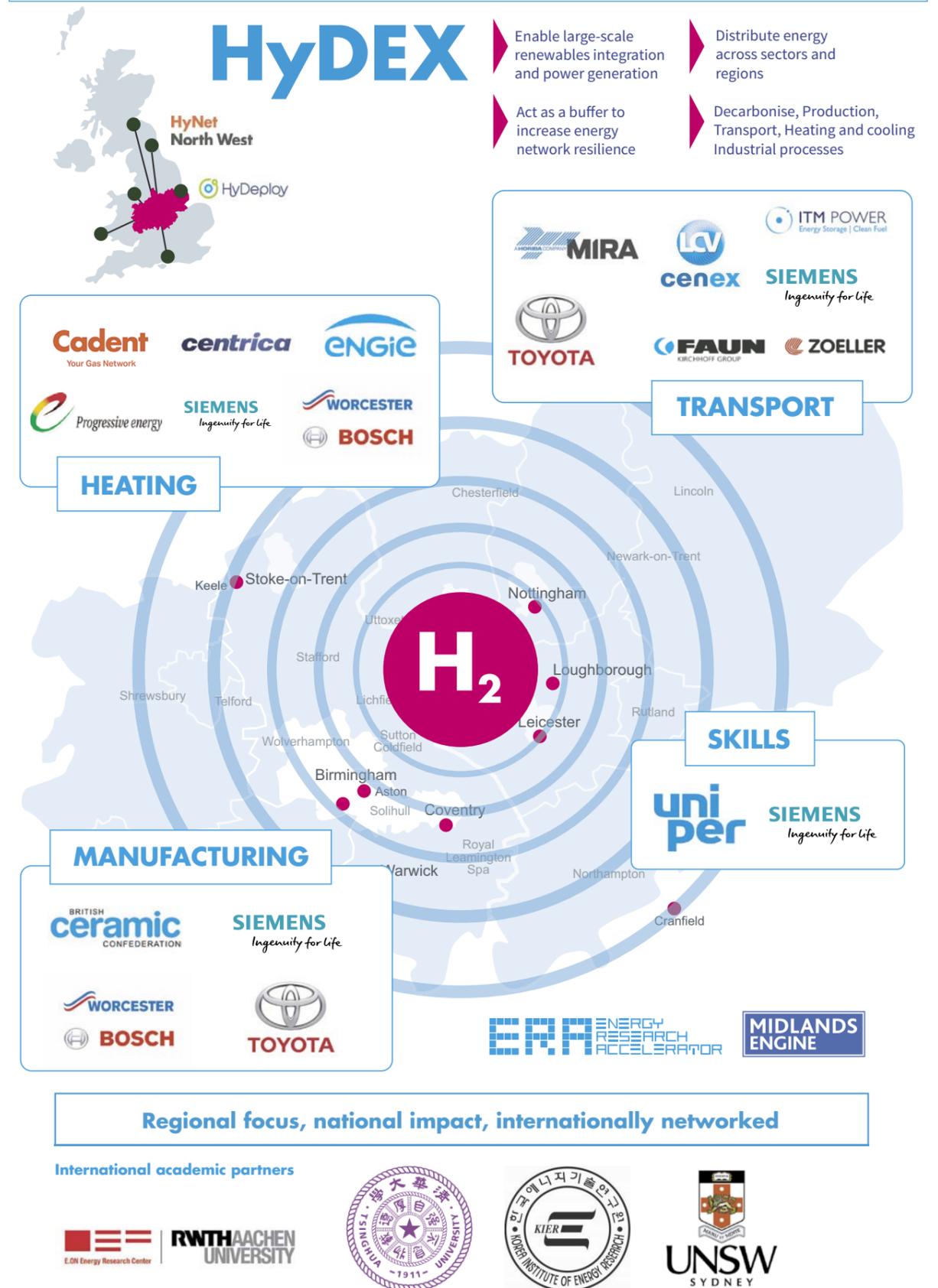


Figure 7: Schematic showing the role the HyDEX project could play by developing a hydrogen ecosystem in the Midlands.



# 6

## BIG IDEA

# MIDLANDS HYDROGEN FREIGHT AND PUBLIC TRANSPORT SYSTEM

**AIM: TO ESTABLISH A SERIES OF CONNECTED PROGRAMMES TO DEVELOP A MIDLANDS HYDROGEN TRANSPORT SYSTEM FOR HEAVY VEHICLES FROM TRUCKS TO BUSES AND TRAINS**



## OVERVIEW

### The case for hydrogen transport in the Midlands

The Midlands is key for the UK's transportation. It is at the heart of the UK's road and rail networks and as such it offers unchallenged accessibility to the UK's population with around 90% being within four hours travel time. In the East is Immingham, the biggest port on the Humber with access to deep water channels permitting servicing of larger ships. In the middle is East Midlands Airport, the UK's busiest pure-cargo airport and second only

to Heathrow, handling over 320,000 tonnes of flown cargo every year and the location of the East Midlands Freeport. In the West is Jaguar Land Rover's plant set for the production of electric cars, the Battery Industrialisation Centre and a potential Gigafactory. The region is criss-crossed by the rail and road network and has a key role to play in freight and logistics; 45% of British rail freight and 33% of heavy road freight goes to or through the Midlands region. It is also home of cities which are implementing Clean Air Zones that will impact how goods are transported into and around these cities.

## Hydrogen buses

Integrating waste and recycling with energy, fuels and transportation solutions for the City of Birmingham, the Tyseley Energy Park (TEP) is an Energy Innovation Zone being developed in the City of Birmingham to help drive the transformation of the city to meet its plan for decarbonisation and the development of a clean air zone. Situated on the site of Webster and Horsfall's existing manufacturing facility, TEP integrates energy from waste plants with electricity and fuels production.

The 10 MW biomass plant feeds the 3 MW ITM electrolyser for the production of hydrogen for 20 hydrogen buses and public hydrogen refuelling. The low-carbon refuelling hub is part of the Birmingham City Council strategy to reduce emissions and deliver net-zero transportation.

Tyseley Energy Park is presently exploring the scaling up the hydrogen production at a scale that would cater for several hundred trucks, with a 35 MW plant with 350 MWh of storage. The business case for this investment is under development.

## Hydrogen trains

The HydroFLEX project is a partnership between the Birmingham Centre for Railway Research and Education and railway rolling stock company, Porterbrook. It demonstrated how hydrogen could be deployed across the rail network to offer a cleaner alternative to current diesel trains. The successful completion of mainline testing took place in September 2020, where HydroFLEX was trialled on the UK mainline. The further development and deployment of hydrogen powered trains is the next stage of development.

## Hydrogen HGVs

Since the mid-1990s, the most significant growth in types of HGVs has been in articulated HGVs over 41 tonnes gross vehicle weight, which were initially allowed on British roads in the early 1990s but only when moving containers to/from rail terminals, but were then permitted for all freight traffic from the early 2000s. By 2018 around 115,000 HGVs over 41 tonnes were registered in Great Britain. Fuel cell and hydrogen (FCH) technology is a very promising zero-emission powertrain solution for the heavy-duty trucking industry.

To make the total cost of ownership of FCH HGVs production volumes need to be ramped up, and distributed hydrogen refuelling infrastructure is needed to deliver the hydrogen at a competitive price. Even though the logistics base might exist across the Midlands region to support a FCH fleet there are a number of significant coordination and synchronisation challenges that need to be overcome:

- The right balance and distribution of refuelling infrastructure needs to be established that provides a commercially attractive proposition to site owners and refuelling developers, which can accommodate a phased introduction without providing under or over capacity.
- The confidence for fleet operators to purchase or lease hydrogen trucks when the technology is new to market and initially there will be a price premium.
- The confidence that the volume of demand is present for truck manufacturers to bring FCH HGVs to the region, and eventually Midlands based manufacturing.



## OUR PROPOSAL

### Midlands hydrogen freight and public transport system

The ERA universities have taken a leading role in the development of hydrogen technology and infrastructure. Within the partnership there is expertise in hydrogen fuel cells, with the development of fuel cell powered cars, boats, houses and trains and projects such as HyPER, HyDeploy, HydroFLEX and Tyseley Energy Park. We have also recently been awarded the H2GVMids project allowing us to undertake a feasibility study for hydrogen freight across the region, with a view to scaling up to several hundred hydrogen powered 44 tonne trucks.

There is an opportunity for the Midlands to become the region of hydrogen transport. As such, ERA is developing a proposal for an East Midlands Hydrogen Innovation Zone associated with the development of the Ratcliffe-on-Soar power station site, the East Midlands Airport and the East Midlands Freeport. ERA will develop a programme working with industry, local and regional government to:

- Create the Midlands hydrogen transport stakeholder group and develop a joined-up regional plan for hydrogen transport
- Work with partners to secure a city scale pilot of hydrogen powered public passenger trains
- Purchase and trial, with a logistics operator and refuelling company, a 44 hydrogen tonne truck

- Work with the Humber ports, East Midlands Airport, Midlands Connect to develop projects which would establish hydrogen-based freight logistics to and from key Midlands locations, building on the outcomes of the H2GVMids programme
- Develop the first stage pilot of the East Midlands Hydrogen Innovation Zone

This would be an impact-led programme involving the two Catapult partners, ERA institutions, industry partners and the transport industry to develop pilot programmes that aggregate into joined-up hydrogen transport infrastructure over a period of 5-10 years. This will be established through a series of hydrogen-for-transport pilot programmes which both utilise existing refuelling infrastructure and install new hydrogen generation and refuelling, and work with business partners to trial hydrogen transport in the region.

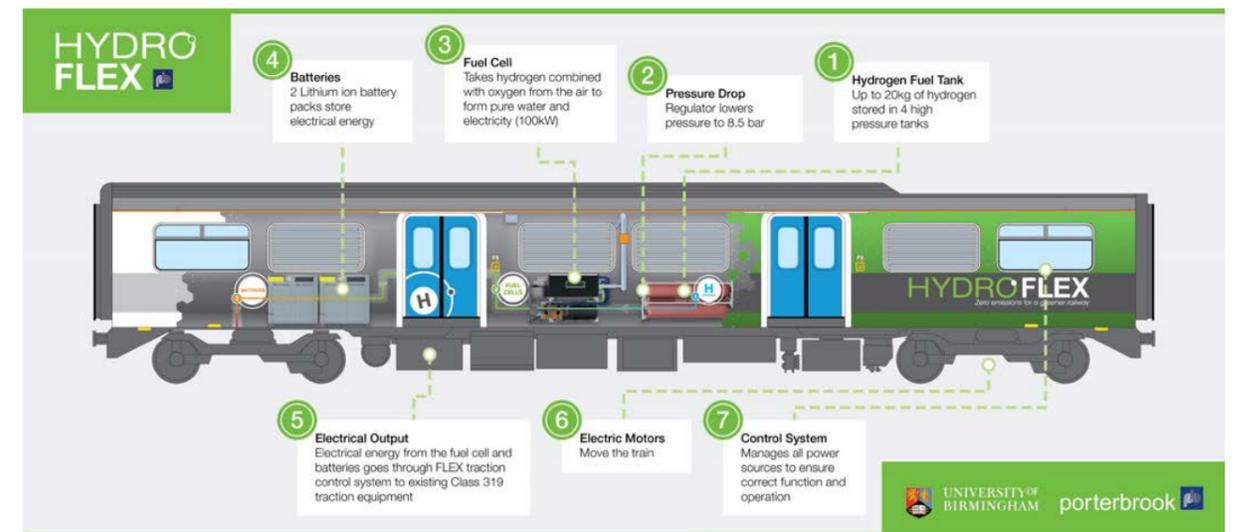
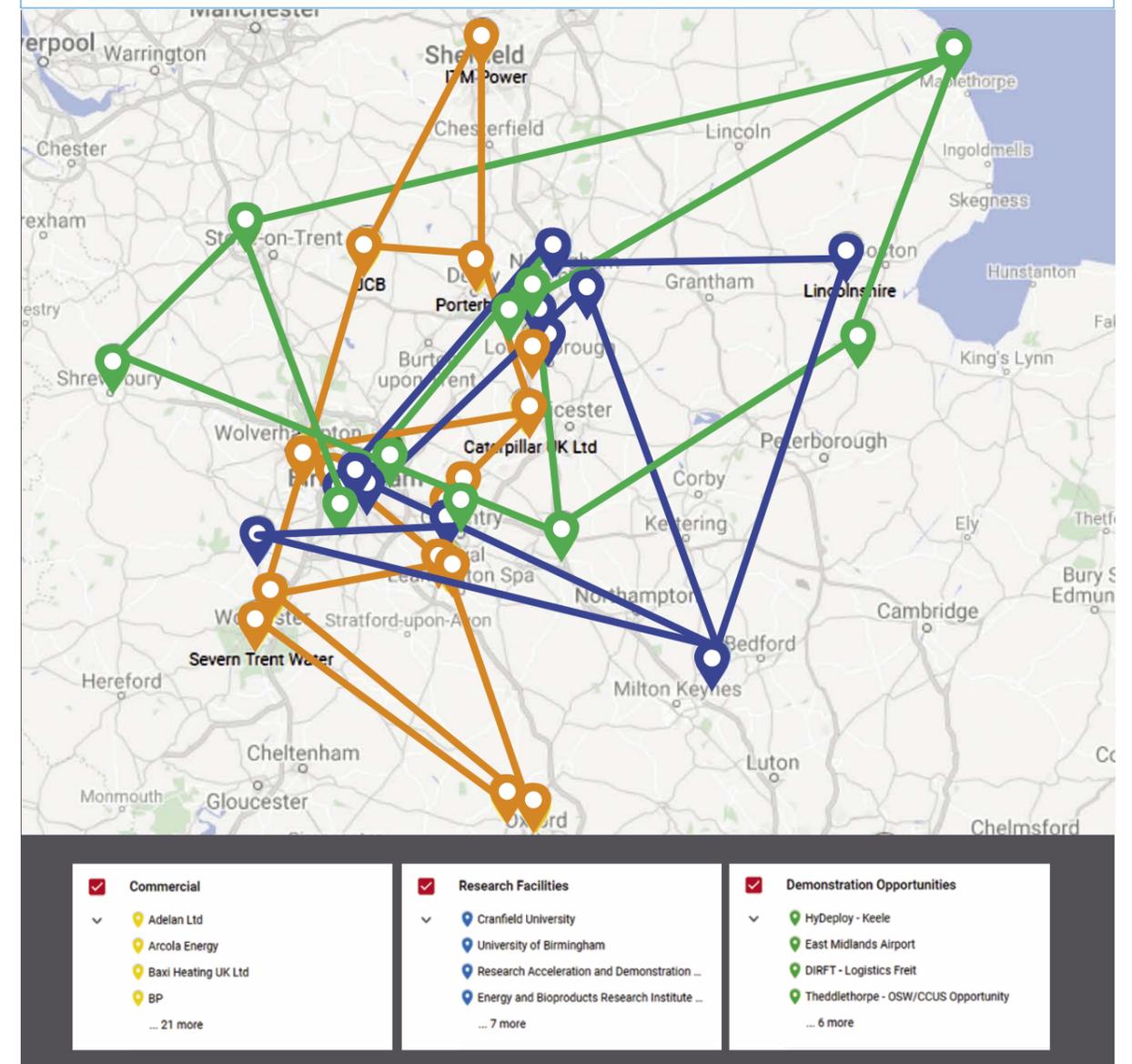
### THE IMPACT

The Midlands Hydrogen Freight and Public Transport System aims to break the ‘chicken-and-egg’ impasse connected with the inability to deploy hydrogen transport due to a lack of refuelling infrastructure and the block on deploying refuelling infrastructure because there is not the ‘market pull’. The hydrogen-for-transport pilot programmes will demonstrate to the industry how hydrogen is a viable, affordable and practical alternative to fossil fuels.

Pictured: Hydroflex test train and [opposite page] technical specification diagram.



Figure 8: Key hydrogen activities developing across the region, including commercial, research and demonstration locations.



# REGIONAL ENERGY EVIDENCE AND FACILITATION TEAM

**AIM: TO PROVIDE SUPPORT TO POLICY-MAKERS AT A LOCAL, REGIONAL AND NATIONAL SCALE**

## OVERVIEW

### Our role in policy development

The complexity of decision making around delivery of net-zero both at a local and national level is extraordinarily high. Examples include the role of hydrogen in transport and the roll out of low-carbon heating where there is difficulty evaluating the relative role of heat pumps, hydrogen boilers and district heating and the infrastructure requirements and associated costs. The Energy Research Accelerator partnership has a track record of developing policy reports which support local and national thinking. In 2016 a joint report “Powering West Midlands Growth: A Regional Approach to Clean Energy Innovation” was published which developed the concept of Energy Innovation Zones, which led to the creation of five Energy Innovation Zones, including the redevelopment of the Rugeley coal power station and Tyseley Energy Park. In 2020 two policy commissions were published focussing on “The Road to Low-Carbon Heat” jointly with the CBI and “Energy from waste and the Circular Economy”. In 2021 ERA worked with the Midlands Engine to create the Midlands Engine’s Ten Point Plan for Green Growth.

## OUR PROPOSAL

### Future support for policy

ERA will continue to play a strong role in supporting local decision making associated with the energy transition and developing regional policy. ERA commits to continuing to develop and influence regional and national policy and support regional decision making around energy planning. ERA will work in tandem with its partners the Energy Systems Catapult, Energy Capital, Midlands Energy Hub and Midlands Engine. The programme will have two threads:

- Development of an ERA-led Regional Energy Evidence and Facilitation programme (REEF)
- Focused Policy Commissions on regional and national areas of importance

### Regional energy evidence and facilitation (REEF) programme

Mirroring the Midlands Engine Economic Observatory, which provides economic advice and guidance into the Midlands Engine, ERA will work with the Energy Systems Catapult, the Midlands Energy Hub, Energy Capital and the Midlands Engine Economic Observatory to establish a team of experts in energy infrastructure, systems and technology, which can work with the LEPS and regional government across the entire Midlands. This team, drawn from the academic research base but supplemented by sector experts, e.g. from the Energy Systems Catapult, would provide advice on local area energy planning, optimal system solutions and navigation of the complex technical minefield of competing energy solutions from business - providing independent advice.

It would also support the region as a whole and individual LEPs and councils as they transition to net-zero. The team would be aligned with ERA and the Midlands Engine and would open the doors to regional government to the expertise of over 1000 researchers and sector experts in energy systems, technology, economics policy and planning. The team would also work with each of the Big Idea areas, supporting them in developing policy analysis and briefings, and also on business model development for their particular areas of interest.

### Policy commissions

The model of the policy commission is that of a distinguished chair and ~10 sector experts that meet to debate, shape thinking and form policy recommendations. This takes place over a period of 6-9 months and usually involves a number of evidence-gathering sessions. The policy commissions will target key questions which need

to be addressed as part of the regional energy transition. There are some emerging themes which will take priority:

- Green finance and unlocking investment into low-carbon projects
- Planning for local heat delivery
- Role of hydrogen in local energy systems
- Creating diversity in the energy sector in academia and business
- Devolvement of regional powers required to deliver the energy transition

## IMPACT

ERA is well very well connected in the Midlands, and our work in policy development will ensure that there is strong technical, academic, industrial and local authority input into regional policy development. We will also use our expertise to provide support to national government and advisory bodies.



Pictured: Policy commissioners meeting for energy from waste. Reports from policy commissions that ERA has been involved with.

# CLEANTECH BUSINESS SUPPORT

**AIM: TO SUPPORT THE DEVELOPMENT OF SMES IN LOW-CARBON SECTORS DELIVERING EXPORTS, SALES AND SECTOR AND JOBS GROWTH**

## OVERVIEW

### The need for low-carbon sector growth in the midlands

The low-carbon sector is now the fastest growing sector in the Midlands. The environment is extremely competitive and to succeed in these changing, and often highly technical market places, UK businesses need access to the best applied technologies, business insight and knowledge that is available. Until recently this has been supported by ERA partners via local ERDF support. As this funding dries up we aim to continue to support the development of low carbon industry, but at a pan-regional level, to provide more sophisticated and targeted support to businesses by working right across our partnership to find the best expertise available to fast-track the development of industry in the region.

### Success in new global markets

Over the two years prior to COVID-19, global markets saw major growth in demand for low carbon energy and sustainable products and it is estimated that the UK low-carbon economy could grow by 11% per year between 2015 and 2030, which is four times faster than the rest of the economy, potentially delivering between £60 billion and £170 billion of export sales by 2030. This is driving major restructuring of production processes and supply chains and offers significant opportunities for UK companies in both domestic

and export markets. COVID-19 places additional pressure on UK SMEs which have endured significant disruption and are now looking to re-build their businesses. At the same time, the entrepreneurship of energy sector businesses, combined with the knowledge base and capabilities that the ERA universities offer, present the potential for high levels of sustainable growth.

### Supporting innovation

ERA and the Midlands region are an ideal platform from which to drive growth from these new opportunities. ERA universities have supported over 1,000 of the region's SMEs to develop their business through R&D support, masterclasses and networking. This has been delivered through the ERDF programmes which are now coming to an end. In 2021 ERA opened its first cleantech business incubator at Tyseley Energy Park with funding from HSBC. This has created a Climate Innovation Platform, jointly delivered with the Energy Systems Catapult. ERA has a track record of working in industrial partnerships and collaborations and has successfully equipped industry partners to work in energy and sustainable product environments. This has resulted in over £110m of industrial collaborative projects and overall £450m of additional investment associated with Midlands projects.

## OUR PROPOSAL

### A business support programme

The ERA partnership will build on its existing track record to deliver targeted programmes aimed at continuing to deliver substantial economic growth. These activities will:

- Grow business support and incubation opportunities across the Midlands.

- Support access to the 23 ERA Phase 1 facilities across the partner institutions.
- Interface with already-funded demonstration facilities which will act as specialist hubs to provide a focus for commercialisation and deployment of diverse integrated solutions.
- Deliver a targeted set of masterclass workshops to build the capacity of business decision makers to work with new technologies and enter new markets.
- Support new product development through an analysis and testing programme able to assess raw materials, processes and products.
- Support the development of business cases through workshop analysis of markets, risks and returns.
- Increase the capacity to commercialise businesses by a co-ordinated programme of secondments and business engagement between academia and industry across the region.

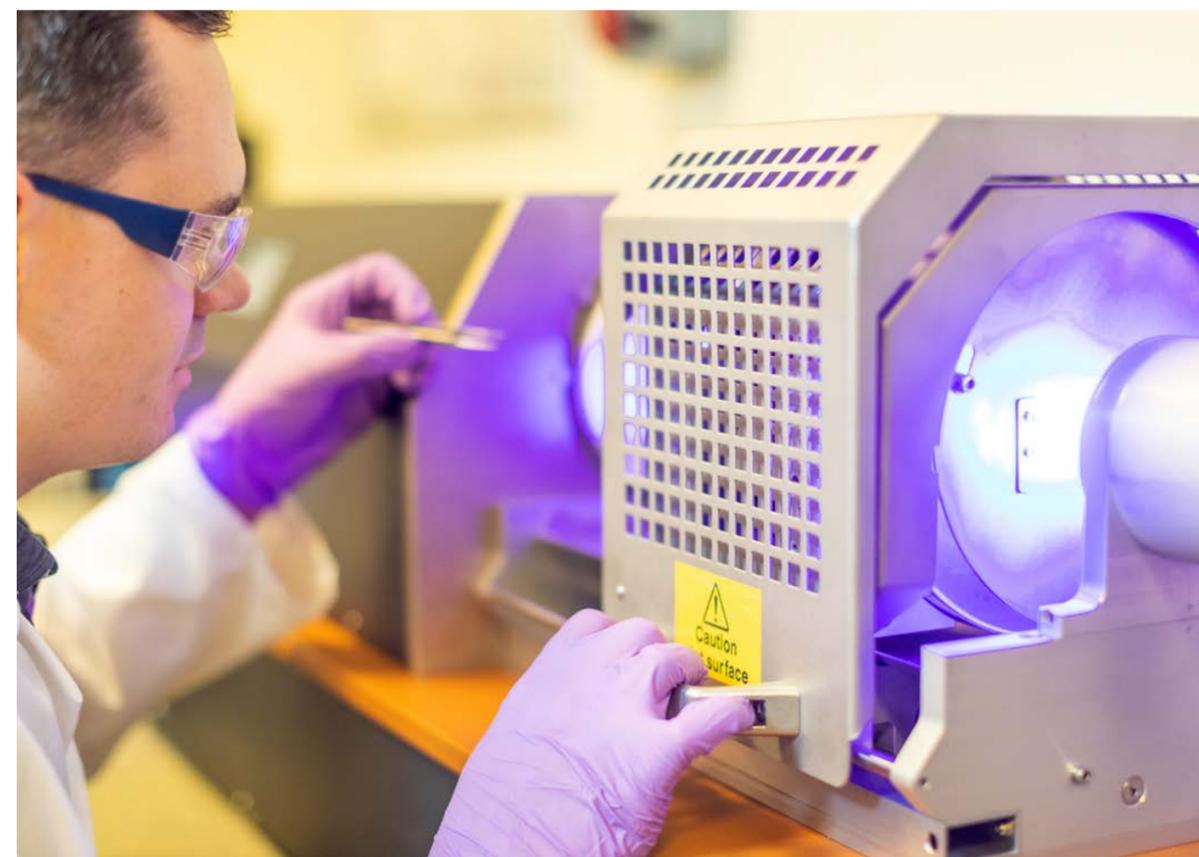
- Stimulate investment into energy, low-carbon and sustainable products and services through focused support and relationships with investor networks, business angels, banks and finance professionals.

With all activities, care will be taken to interface with other successful sources of support such as Knowledge Transfer Partnerships, Innovate UK and other research funding.

Funding Cleantech Business Support would enable many of ERA's partner universities which are currently delivering European Regional Development Fund (ERDF) programmes to SMEs to continue this invaluable work into the future.

## THE IMPACT

Our proposed business support programme will support SMEs in the low-carbon energy sector, delivering export sales and business growth, leading to significant job creation.



# KNOWLEDGE EXCHANGE FROM LIVING LABORATORIES

**AIM: TO UTILISE THE 'LIVING LAB' CONCEPT TO BUILD ON THE EXISTING INVESTMENT IN DEMONSTRATORS AND DEVELOP FURTHER LIVING LABS.**

## OVERVIEW

### The importance of Living Labs and Energy Innovation Zones

A key feature of the ERA programme has been the integration of large-scale demonstration of energy systems and energy technologies and we have identified a number of different living labs and demonstrators that we would like to support:

- University Campus Living Labs and Demonstrators, such as Keele University
- Community Living Labs and Demonstrators, such as Trent Basin
- Energy Parks, such as Tyseley Energy Park, Rugeley and Ratcliffe-on-Soar Power Stations
- City Network Living Labs, such as RESO in Coventry, PIRI in Peterborough and East Birmingham
- Rural Network Living Labs
- Major transport Living labs, such as Birmingham International and East Midlands Airports

## OUR PROPOSAL

ERA is active in, and wants to support the development of, a range of Living Labs, Demonstrators and Energy Innovation Zones across the region and beyond. To do this ERA will:

- Identify existing Living Labs and bring together case studies of best practice to provide a resource for use across the UK and beyond
- Provide individual technical support to Living Labs and Energy Innovation Zones to determine potential system solutions suitable for the site and help to plan for the site's development
- Provide business support by identifying and bringing in potential partners and fostering collaboration
- Deploy technological developments from ERA programmes into the Living Labs as part of scale-up and demonstration programmes

The following are some examples of the success of the Living Lab concept:

## UNIVERSITY CAMPUS

### Case Study: Keele University

The Keele University campus has been a flagship demonstrator for two ground-breaking energy projects, HyDeploy and SEND. HyDeploy is a green energy trial associated with a low-carbon hydrogen economy. The HyDeploy demonstration injected up to 20% (by volume) of hydrogen into Keele University's existing natural gas network, feeding 100 homes and 30 faculty buildings. The Keele University Smart Energy Network Demonstrator (SEND) is a multi-vector smart network providing low carbon energy to over 13,000 students and staff daily. It is delivered in collaboration with a number of companies, including Siemens, that

allows energy generation, distribution, storage, forecasting and energy balancing to be intelligently carried-out across different energy sources using the Keele University campus as a living lab. Keele provides the template for the modernisation of the energy infrastructure of the Midlands universities as they move to reach goals of sustainability and zero carbon.

## COMMUNITY LIVING LABS

### Case Study: Trent Basin

Trent Basin is an innovative and contemporary neighbourhood, delivered by developers Blueprint as part of the 250-acre Waterside regeneration area in Nottingham, and set to deliver 500 new low-energy homes once complete. The £100m scheme, now starting its third phase of build, is also the site of a transformational energy project that hosts one of Europe's largest community energy batteries. Project SCENE (Sustainable Community Energy Networks), a pioneering community energy pilot is being supported by £10m of Innovate UK and ERA investment, match-funded and delivered by a consortium of public and private sector partners, including Blueprint and ERA.

The aim is to accelerate the adoption of community energy systems by offering a different way of generating and supplying locally-generated heat and electricity to homes and commercial buildings. This pilot intends to develop a viable model that can deliver renewable energy generation on new urban developments, which in turn generates financial returns for the community to offset energy costs. Solar photovoltaics are installed on the site, along with the communal battery. A unique community energy company has also been established and residents that have opted to join are provided with Amazon's new Echo Spot, smart thermostats (Honeywell EvoHome) and additional in-home monitoring equipment that is accessible from a purpose-built app. Blueprint will continue to build on this offer in future phases, eventually offering a full suite of smart technology, from appliances to security features. The Trent Basin project will continue to be an important demonstration environment, allowing the creation of business models which meet government sustainable living targets in a way which is financially stable and future-proof. In ERA-2, the Trent Basin energy infrastructure will be extended to new developments, for example a school which is being constructed adjacent to the site.



## ENERGY PARKS

### Case Study: Ratcliffe-on-Soar

The closure of 1970s era coal-fired power stations is a significant issue for the Midlands, with a number of such sites in need of redevelopment. The generation of electricity from coal created significant regional employment. The Uniper-owned Ratcliffe-on-Soar station lies adjacent to the M1 and M42 intersection, the East Midlands Airport, potentially the HS2 extension and a regional development programme managed through the East Midlands Development Corporation. The existing grid infrastructure and the location make it an attractive site for redevelopment and the co-location of energy, transport and waste and reprocessing infrastructure. It is envisaged that three or four of the Big Ideas developed by the ERA partnership could be potentially located at Ratcliffe-on-Soar as part of the economic regeneration which is a necessary part of the just transition. This development would mirror the excellent development made at the Rugeley coal power plant in the West Midlands, where the demolition of the power station is the catalyst for the redevelopment of the town with a population of 25,000 people.

## CITY NETWORK LIVING LABS

### Case Study: West Midlands Regional Energy Systems Operator (RESO)

The West Midlands Regional Energy Systems Operator (RESO), being led by Energy Capital, explores the advantages of a new kind of energy system operating at a city scale. The system, currently being designed for Coventry, will include local low-carbon energy generation, storage and management, and will integrate future mobility assets such as electric vehicles. This local smart energy system takes advantage of the large detailed data flows supported by superfast digital networks, optimising local energy flows. The mapping of the energy system and collation of the energy data is being performed by ERA academics. This approach is already being developed at a campus scale at Warwick University, but the RESO project seeks to understand whether it can be applied at a larger scale with multiple customers.

### Case Study: Peterborough Integrated Renewables Infrastructure project

The Peterborough Integrated Renewables Infrastructure project (PIRI) combines a next-

generation heat network, electricity network and EV infrastructure under one scheme. Led by Peterborough City Council, the two-year project has been granted funding to begin the design of a local, smart energy system. The partnership includes: SSE Enterprise, Element Energy, Cranfield University, Smarter Grid Solutions and Sweco UK. This project provides the perfect opportunity for ERA to help influence the development of one of the fastest growing and progressive UK cities which has set a net-zero target of 2030.

## RURAL NETWORK LIVING LABS

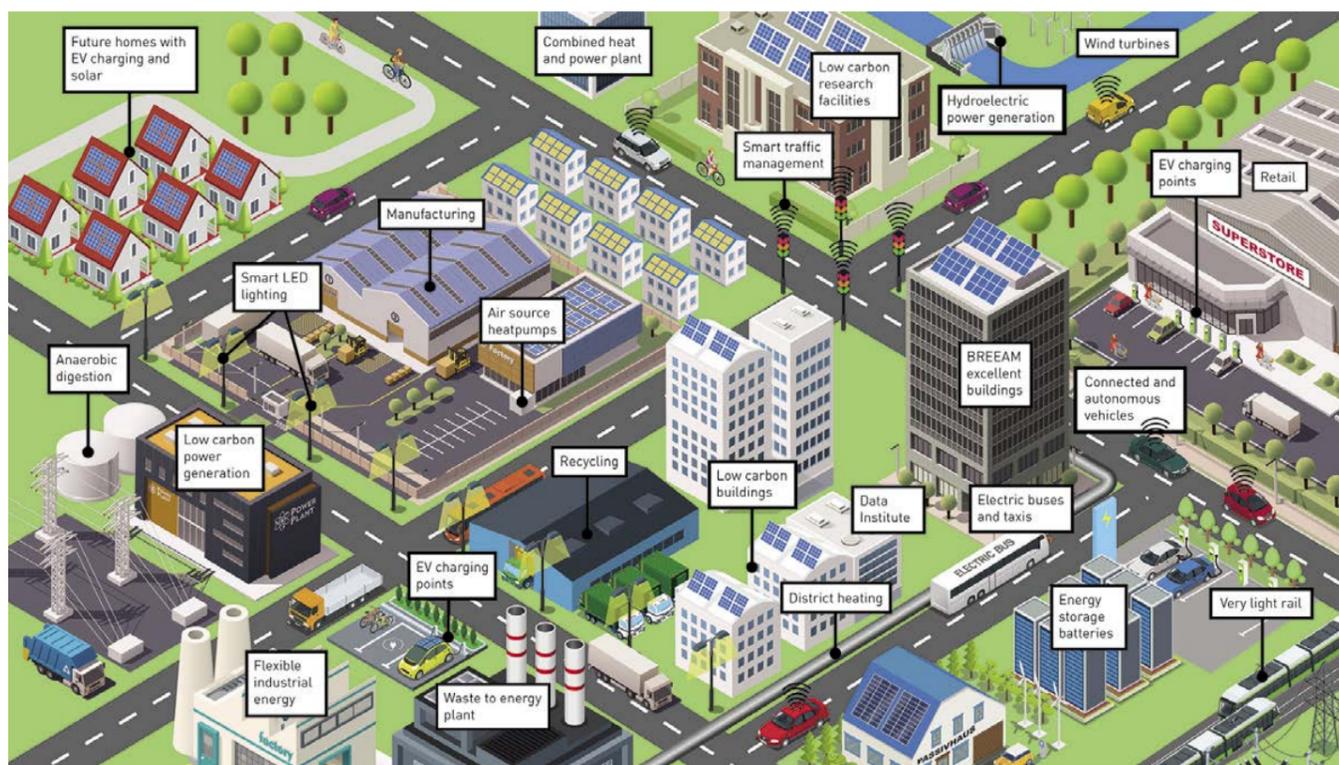
A considerable portion of the Midlands is rural, particularly to the east and west of the regions. These areas have their own energy challenges and opportunities. Many houses are effectively off-grid in terms of energy supply and mainly rely on fossil fuel sources of energy being delivered to homes. Transportation often involves large distances; agriculture is a key sector and there is the challenge of both decarbonising this sector but also utilising the waste produced to form low-carbon electricity, fuels or chemical feedstocks. We propose to support these areas using the Living Lab concept to develop a rural test bed where we can pilot solutions appropriate to the geography. Examples of technology solutions include hydrogen and electric vehicles, BioLPG in houses and Heat Pumps.

## MAJOR TRANSPORT LIVING LABS

### Case Study: Birmingham International Airport

Birmingham International Airport has set an ambitious net-zero target date of 2033. Pre-COVID-19, the airport had already cut its carbon emissions since 2013 by 33%, and emissions per passenger by over 50%, despite a 40% growth in passenger numbers, however there is still much to be done. Much of the heat for the airport is delivered by gas and there is a need to continue to develop a sustainable plan for aviation around the airport. For aviation more generally, there is a need to develop sustainable, low-carbon, aviation fuels. ERA will work alongside the airport's sustainability team to help shape the future energy system, and also to link in the Big Ideas with potential incorporation of emergent technology into the airport's development.

Pictured (below): illustration schematic of Coventry Innovation Zone. Opposite page: Keele Living Lab SEND project, Ratcliffe-on-Soar power station, rural energy solutions, and Birmingham International Airport.



# ERA RESEARCHER AND SECTOR SKILLS PROGRAMME

**AIM: TO DELIVER A SUSTAINABLE PIPELINE OF FUTURE ENERGY LEADERS AND KNOWLEDGE TRANSFER EXPERTS WHO CAN SUPPORT THE UK'S TRANSITION TO THE NET-ZERO TARGET.**

## OVERVIEW

The vision for phase 2 of ERA Skills is to ensure the success of the energy revolution through the development of people, by addressing the pressing demand for high-level skills in the energy sector to meet the net-zero carbon and clean growth objectives. The ERA Skills programme will develop the research leaders required to deliver these targets, and will establish the transition pathway required to deliver the innovation and systems integration demanded by net-zero.

## OUR PROPOSAL

### Developing researcher skills

We propose to work across the different stages of development, providing an integrated skills programme for the research environment:

- **Schools and undergraduates:** Coordinate a series of placements and secondments which will allow undergraduate and school-age students to experience the energy research environment, building on pre-existing successful placement models.
- **Undergraduate and post-graduate:** Work with our partner universities to establish a joint energy teaching resource and encourage sharing of specialised energy teaching across the partners.
- **Doctoral-level:** Establish ERA Big Ideas cohorts of doctoral researchers and will promote synergies between the Big Ideas themes and

create robust collaborative networks extending beyond the project's lifetime.

- **Doctoral-level:** Provide high-level skills development at doctoral level (e.g. placements, secondments, conferences, specialist skills training), creating cohorts of researchers, and attracting industry-matched funding to research industry-derived research challenges and address high-level skills shortages.
- **Post-Doctoral:** Complementing and scaling the work of the recent £4m Research England Development Fund investment in postdoctoral researchers to establish the Centre for Post-doctoral Development for Research in Infrastructure, Cities and Energy (C-DICE), engaging ERA postdocs as a talent pipeline for working with industry.
- **Technicians:** Extending the skills programme to include technicians both with ERA partners and beyond. To deliver this, ERA will partner with the Research England TALENT programme to access specific expertise in relation to the needs and interests of technicians. We will also engage with the Midlands Innovation Technical Staff Strategy Group which brings together technical managers from ERA's partner institutions.
- **Continuing Professional Development:** Establish a suite of executive education packages for UK industry (linked to the apprenticeships levy) and for the international market to cement ERA's place as a leader in research and skills, and to create a sustainable model.

To facilitate this ERA will:

- Develop Communities of Practice around the six Big Ideas for skills development and coordination across the cross-cutting themes to provide networking across academic career stages and industry. These will form the basis of a network across the career development pathway for each Big Idea area, bringing together PhD students, postdocs, technicians, research fellows and established academics.

- Establish an ERA Researcher Concordat Action Plan.
- Establish a transparent process for ERA researchers, at all career stages, to become part of the ERA Community.
- Provide training and a programme of activities on equality, diversity and inclusivity across the breadth of the partnership, working from students through to senior academics.

## SECTOR SKILLS

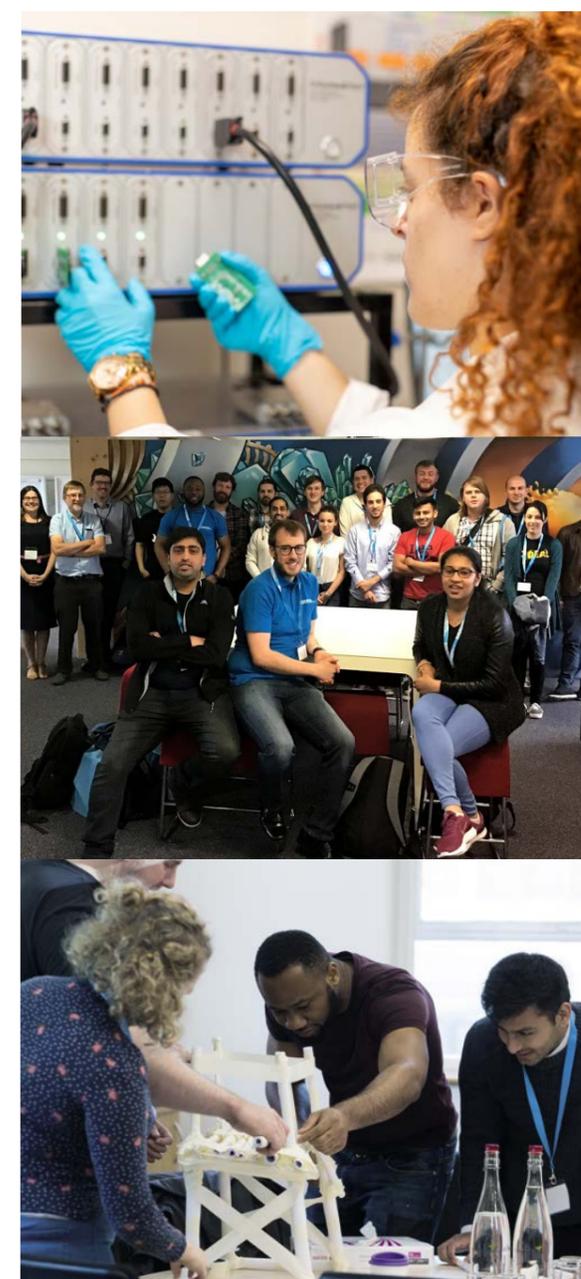
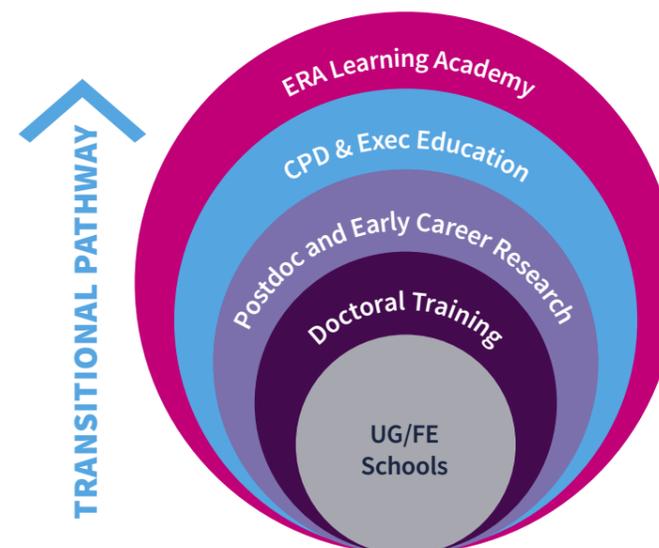
In addition, whilst it is recognised that the skills agenda for the wider energy sector is a substantial activity in its' own right, ERA will work in collaboration with other key stakeholders to:

- Help identify future needs for apprenticeship and reskilling programmes as the sector transitions.
- Develop specific skills programmes in particular thematic areas, such as in relation to the need to transform the provision of heat to homes and the likely investment in skills needed to provide a workforce to do this.
- Develop an Energy Academy which would focus on skills development at the Higher Education/ apprenticeship level where there is a perceived skills gap.

## THE IMPACT

Our Skills proposal will help to develop the energy skills needed for industry and academia, ensuring that the Midlands, and UK more widely is equipped to stay at the forefront of energy innovation.

Figure 9: ERA Learning Academy Vision



## KEY

- Undergraduate/Further Education/Schools – Outreach activities/Apprenticeships
- DTP – Doctoral Training Partnership to PhD level
- Early career training – Post-Doctoral and early career researcher support
- Lifelong learning – CPD and executive training
- ERA Skills Academy

# ECONOMIC BENEFITS

**Table 1:** This table outlines our proposed programme and the benefits of each of the ideas and themes. The funding will be used to support a mixture of both capital and revenue expenditure.

Proposal component	Benefits	Net-zero	Levelling up (Skills, jobs)	Science Superpower
<b>1. National Facility for Energy Storage Scale Up and Demonstration</b>	This provides a way to store renewable energy to maximise use and cost effectiveness on the grid.	X		X
<b>2. National Centre for Decarbonisation of Heat</b>	Provide solutions to decarbonising domestic (and industrial) heating which is currently difficult to decarbonise. Provide coordination across the range of solutions allowing the best solutions to be developed and deployed at scale.	X	X	X
<b>3. Midlands City Scale Digital Twins</b>	Support city resource planning by being able to understand and manage energy, transport and resource flows in real time.	X	X	X
<b>4. National Centre for Low Carbon Alternative Fuels</b>	Speed up adoption of low carbon fuels in marine, transport and heat sectors by supporting synthesis of fuels, developing appropriate standards and policy and understanding sustainability of fuels.	X		X
<b>5. Midlands Hydrogen Innovation Support Platform</b>	This will create a Midlands-wide hydrogen innovation platform to support SMEs and manufacturers in deploying hydrogen technologies.	X	X	X
<b>6. Midlands Hydrogen Freight and Public Transport System</b>	Support the development of a hydrogen economy with a focus on transport and logistics across the Midlands region, reducing national GHG emissions. Develop expertise that is deployable internationally.	X	X	
<b>CC1 Regional Energy Evidence and Facilitation Team</b>	Expert team that would provide advice on regional energy issues by working with LEPs, industry and other stakeholders to develop low carbon strategies for the region and provide an evidence base for future decision making and prioritising energy investments in the region. Series of "policy commissions" to provide a focus on specific issues of relevance to the region in order to initiate new approaches, unlocking areas of difficulty such as fuel poverty, funding and investment.	X	X	
<b>CC2 Business Support</b>	Business support to SMEs to support both the development of new innovative companies addressing low carbon solutions in the sector and implementation of low carbon technologies into businesses in the region to increase their effectiveness and reduce emissions.	X		X
<b>CC3 Living Labs Knowledge Exchange</b>	Knowledge exchange between living lab environments and bringing together evidence for the deployment of future energy solutions both in the UK and internationally.	X		X
<b>CC4 ERA Researcher and Sector Skills Programme</b>	Development of future energy leaders for academia and the sector.		X	



# SUPPORT AND MATCH-FUNDING

**ERA has support from a range of industrial and civic organisations as well as support from its research partners with collaborators who have proposed support for this initiative shown including those in the back and front inside covers of this brochure.**

As part of this submission, a selection of letters of support have been submitted in the short time-frame which we have been working over, however they highlight individual organisations' interest and support for the proposal. Whilst we are currently at a difficult time to be requesting funding in kind from organisations we have had a large number of positive conversations with both existing and new partners. At present we have identified £1.4bn combined in match-funding and strategically aligned projects from the industrial organisations we are in discussion with. We are confident that whilst we continue to develop these conversations and over the lifetime of any funding that we will be able to deliver a similar level of match-funding to ERA I (i.e. 2:1).

## INDUSTRIAL SUPPORT

Industrial organisations offering support range from large energy sector organisations interested in new solutions to complement their current portfolio of activities, to users of energy and transport looking for lower-carbon solutions, to SMEs active in the green energy sector that want to innovate and grow. Key areas of support include the following:

- Argent Energy
- Cadent
- Cambridge Carbon Capture
- Cenex
- Central England Co-operative
- City Clean Autogas
- CoGen

- Cumulus Energy Storage
- Day Associates
- E.ON
- EDF Energy
- Electric Power Research Institute
- Elexon
- Energy SRS
- Engie
- Focus Consultants
- Freeland Horticulture Ltd
- Geely
- Intelligent Energy
- James Hutton Institute
- Kew
- Liquid Gas UK
- Microx
- Network Rail
- Porterbrook
- Renewable Energy Association
- Severn Trent
- Siemens
- Sky East
- Synthos Green Energy
- Tyseley Energy Park
- Vital Energi
- Wave Industries
- Western Power Distribution
- Worcester Bosch
- WSP

## CIVIC SUPPORT

We have gained support from the programme from the Midlands Engine who see the proposal as strengthening the Midlands focus on energy:



Further investment in ERA will place the Midlands and the UK at the very heart of the energy revolution, giving businesses access to world-class energy expertise and facilities, and creating new, high-skilled jobs, helping in the effort to level-up the region with other parts of the country. ...The Midlands Engine wholeheartedly supports the Energy Research Accelerator's bid, and I do hope that you look favourably upon their proposal".

We have support from a number of LEPs and councils in the region, including Coventry and Warwickshire, D2N2, GBS, Greater Lincolnshire, Leicestershire LEPs and Birmingham City Council. For example the Greater Birmingham and Solihull LEP stated:



The proposal has strong alignment with GBSLEP's strategic priorities as it enables the growth of the low carbon business sector, supported through the delivery of the Low Carbon Sector Action Plan as part of the Local Industrial Strategy.

Furthermore, this proposal will help to address some of the biggest challenges posed by the climate and Covid-19 emergencies, by delivering clean growth and green recovery opportunities, which are critical to enable long-term economic stability and prosperity".

As with many civic organisations support in kind will be via staff engagement in our projects and programmes as they take place in their area and attendance at our regular dissemination and discussion events. There are also major projects such as RESO in Coventry (see p44) which would become part of a wider community of knowledge exchange.

We also have support from the Midlands Energy Hub who work across the LEPs supporting the implementation of low carbon projects. We have been working more closely with them over recent periods and plan to continue to develop that relationship with us both working collaboratively across the region.

## RESEARCH PARTNERS' SUPPORT

Our research partners, include our eight university partners, the British Geological Survey, plus Energy Systems and Connected Places Catapults and the Manufacturing Technology more details on their specialist areas of activity are given on p54.

The university research partners have agreed to continue funding in kind which will support a significant amount of the central team funding required – this totals around £1.5m in total.

In addition to this co-funding likely to be in excess of that committed during ERA Phase I has been identified.

- Birmingham are committing £800k to the development of the Innovation Hub at Tyseley Energy Park and on-going work with the West Midlands Combined Authority and Greater Birmingham and Solihull LEP to identify, fund and deliver low carbon projects.
- Aston anticipates a contribution of £1–2m from the university in the form of staff time, infrastructure investment, ERA badged studentships and use of equipment and facilities.
- Many of the universities are also likely to provide studentships aligned with the programme, such as Warwick who invested £1m in the previous phase of ERA.
- Loughborough has identified £2.3m in in-kind funding it provided for ERA Phase I, with a similar expectation for Phase II.
- Keele has identified around £1m in match funding it will provide.
- Cranfield has offered £1.25m in match.
- Other universities will provide similar amounts and this will obviously relate to the specific projects they are involved in.

Across the partnership we also have projects that we will integrate ERA-2 with, for example:

- The Centre for Postdoctoral Development in Infrastructure, Cities and Energy (C-DICE) brings together ERA with the UK Collaboratorium for Research on Infrastructure and Cities (UKCRIC) to develop deep technical skills has been funded by a £4m four-year investment from the Research England Development Fund, plus £3.4m in cash and in-kind commitments from 18 leading research-intensive UK universities, related research associations and institutes.
- Cranfield University's HyPER project with £7.5m of BEIS funding to examine the potential for low-carbon hydrogen to be the clean fuel of the future.
- Keele University's £15m Smart Energy Network Demonstrator (SEND) project, and the £8.5m HyDeploy project, the UK's first at-scale hydrogen-blended gas network.
- Keele's involvement in UK Zero Carbon Rugeley.

## UKRI SUPPORT

Innovate UK supported ERA through the first phase of its development, which achieved considerable success, and is very keen to build upon this by supporting ERA Phase 2 – the Big Ideas for a Net-Zero Future.



**Innovate UK recognises the success of the first phase of the Energy Research Accelerator (ERA 1.0). ERA 1.0 provided a model for how different universities can work together in a region to achieve the necessary leadership, economies of scope and scale, diverse and productive Midlands ecosystem needed to engage stakeholders, catalyse and align research, innovation and investment in clean energy."**

## CATAPULTS

The projects also align with key areas of activity for our Catapult partners – the Energy Systems Catapult and the Connected Places Catapult. For example, the CPC commented:



**These ideas are aligned with our own areas of strategic interest, specifically helping places achieve net-zero through adoption of new forms of mobility, data and digital infrastructure. CPC has existing networks and programmes with academia and the SME community which we would be delighted to introduce to the project in support your ambitions, alongside offering dissemination opportunities through our events and engagement programme."**

## MTC

MTC plans to support the Smart Manufacturing component of NCDH in both the manufacturing scale-up of existing low carbon heat technologies, and in the development of designs and standards that will allow next generation technologies to integrate into evolving energy systems.



**The MTC plans to support the Smart Manufacturing component of NCDH in both the manufacturing scale-up of existing low carbon heat technologies, and in the development of designs and standards that will allow next generation technologies to integrate into evolving energy systems."**

# ENERGY RESEARCH ACCELERATOR'S RESEARCH PARTNERS



## ASTON UNIVERSITY

The Energy and Bioproducts Research Institute (EBRI) at Aston University is committed to the research and development of sustainable energy technologies and solutions. Its team of internationally-renowned researchers focuses on methods of generating energy, fuels and chemicals from biomass, wastes and residues.

ERA's investment in EBRI has resulted in new state-of-the-art equipment including a surface imaging machine, a photo-electrical platform and a bioreactor suite. EBRI leads a range of engagement activities which stimulate innovation and knowledge transfer between businesses, scientists and chemical engineers across renewable biomass, biorefining, bioenergy, biofuels and bioproducts.



## UNIVERSITY OF BIRMINGHAM

The Birmingham Energy Institute at the University of Birmingham has over 200 academics engaged in energy-related research and development projects worth more than £200 million. It is driving technology innovation and developing the thinking required to solve the challenges facing the UK as it seeks to develop sustainable energy solutions in transport, electricity and heat supply.

ERA has supported a number of developments involving the University of Birmingham, including the revolutionary 'Factory in a Box' initiative at the MTC, which provides a portable, remotely operated smart manufacturing solution. The Thermo-Catalytic Reformer (TCR) at Tyseley Energy Park is transforming waste into energy, and the heat storage and cryogenic labs at the University of Birmingham are enabling world-leading research to be delivered.



## CRANFIELD UNIVERSITY

Cranfield's expertise in energy and power covers a range of the potential energy solutions. The University's expertise is supported by unique industrial scale experimental facilities across many different kinds of energy systems.

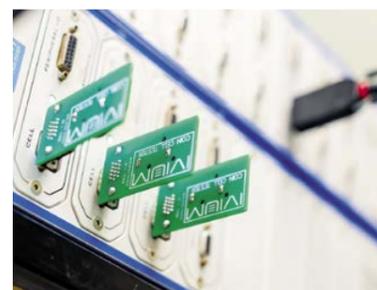
These include an ocean systems laboratory, gas turbines, an anaerobic digestion plant, and high temperature coating test facilities. Cranfield's postgraduate community includes around 200 MSc students from around the globe and 150 full-time doctoral students. Cranfield graduates are working in engineering and management roles across the energy industry and putting their learning into practice.



## KEELE UNIVERSITY

Keele University is the home of the Smart Energy Network Demonstrator (SEND). This world-class demonstrator facility for smart energy research enables the testing and evaluation of new energy technologies. Working collaboratively with Siemens, ENGIE, Cadent and local companies, the SEND programme assesses the efficiency of new technologies in terms of energy reduction, cost and CO<sub>2</sub> emissions.

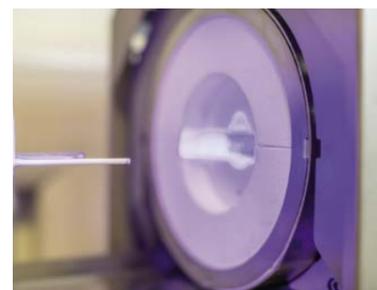
One of the most interesting energy research projects at Keele is HyDeploy, where a 20% hydrogen blend has successfully injected into the campus heating system. If rolled out across the UK it could save 6 million tonnes of CO<sub>2</sub> emissions every year, the equivalent of taking 2.5 million cars of the road.



## UNIVERSITY OF LEICESTER

The University of Leicester has a varied energy research programme coupled to extensive international academic and industrial collaborations that are leading the way in the search for alternative energy sources and greater energy efficiency.

Through ERA's investment, Leicester is playing a leading role in advancing the safety and performance of cell materials and chemistries. These include the development of novel electrolyte technologies to implement the aluminium rechargeable cell. The University of Leicester is also developing novel methods for recycling and recovery of critical raw materials from spent cells.



## LOUGHBOROUGH UNIVERSITY

Loughborough's energy research priorities include energy transformation, energy storage and energy demand. It is also the home of CREST (Centre for Renewable Energy Systems Technology) and has overseen the research and development of the most progressive renewable energy technologies, collaborating with industry and international academic networks.

Research activities at CREST cover a range of technical applications, including wind power, solar PV, energy in buildings, grid connection and integration, and energy storage (including hydrogen). ERA's investment into new laboratory equipment supports Loughborough's leading research.



## UNIVERSITY OF NOTTINGHAM

The University of Nottingham has several research themes with the common goal of developing sustainable energy solutions. Its mission is to develop the best future talent in energy across the sciences, engineering and social sciences and to create world-class research facilities to support innovation and collaboration.

ERA's involvement with the University of Nottingham includes the development of the Research Acceleration and Demonstration (RAD) building, a £12 million facility which is home to state-of-the-art laboratories for compressed air energy storage, hydrogen, materials analysis and carbon capture. Additional ERA funded facilities run by the University include the Trent Basin community energy programme and the Hydrothermal Carbonisation plant which is operational at Immingham with the company CPL.

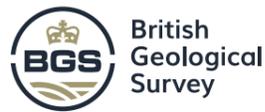


### UNIVERSITY OF WARWICK

The University of Warwick has expertise in a range of energy research areas including electrical power, energy management, storage, low-carbon transport and thermal energy.

The Energy Innovation Centre (EIC) is a world-class facility for battery research and innovation. ERA's investment enabled the University to secure their bid to be part of the £246 million Faraday Challenge, a national investment into battery research. The EIC facilities at Warwick are used by leading industrial partners who use them to develop technologies in energy storage, energy machines, drives and systems.

ERA also invested in new thermal laboratories in Warwick's School of Engineering, which introduced new technologies associated with the development of materials for use in both high and low temperature applications and also sorption heat pump technologies.



### THE BRITISH GEOLOGICAL SURVEY (BGS)

The British Geological Survey (BGS) is the UK's premier provider of objective and authoritative geoscientific data, information and knowledge, to help society use its natural resources responsibly, manage environmental change, and be resilient to environmental hazards.

ERA has funded a GeoEnergy Test Bed for BGS, a £2.4 million investment which has involved the drilling of 11 boreholes at the University of Nottingham's Sutton Bonington site. The geology is similar to that of the North Sea and the boreholes include deep and shallow injection wells which can be used to monitor the motion of gases and liquids through natural pathways in the subsurface after injection.



### THE ENERGY SYSTEMS CATAPULT

The mission of the Energy Systems Catapult is to accelerate the transformation of the UK's energy system, unleash innovation and open new markets to capture the clean growth opportunity. The Catapult is an independent, not-for-profit centre of excellence that bridges the gap between industry, government, academia and research. It takes a whole-systems view of the energy sector, helping to identify and address innovation priorities and market barriers, in order to decarbonise the energy system at the lowest cost.



### THE CONNECTED PLACES CATAPULT

The Connected Places Catapult accelerates smarter living and travelling in and between the places of tomorrow. It focuses on growing businesses through innovations in mobility services and the built environment which enable new levels of physical, digital and social connectivity. The Connected Places Catapult operates at the intersection between public and private sectors and between local government and transport authorities. It helps innovators navigate the complexity of doing business, creating new commercial opportunities and improving productivity, socio-economic and environmental benefits for places.



### THE MANUFACTURING TECHNOLOGY CENTRE (MTC)

The Manufacturing Technology Centre (MTC) was established in 2010 as an independent Research and Technology Organisation (RTO), to bridge the gap between academia and industry – often referred to as 'the valley of death'. The MTC is one of the largest of the seven centres making up the High Value Manufacturing Catapult, representing one of the largest public sector investments in UK manufacturing. Over the following ten years the MTC's rapid growth has seen the expansion of the campus with the construction of four more facilities, including the opening of the Advanced Manufacturing Training Centre and the National Centre for Additive Manufacturing.



The MTC's role has also increased to cover not only traditional manufacturing R&D but also training, business management, SME productivity improvement support, start-up incubation and Factory/Supply Chain/Product Design. In addition to working with traditional manufacturers and sectors, the MTC leads the Construction Innovation Hub, the flagship programme in the Transforming Construction Industrial Strategy Challenge, which is creating the product platform systems for procurement of all government buildings, to ensure they achieve net-zero.

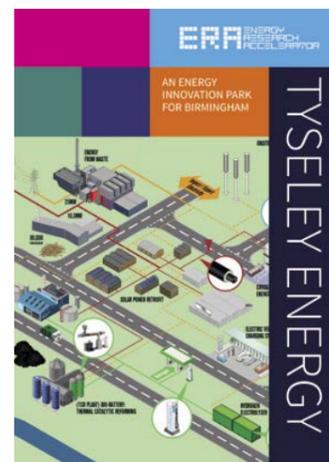
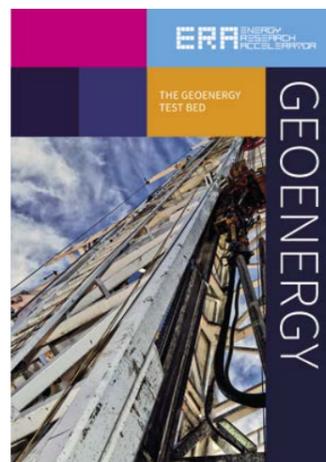
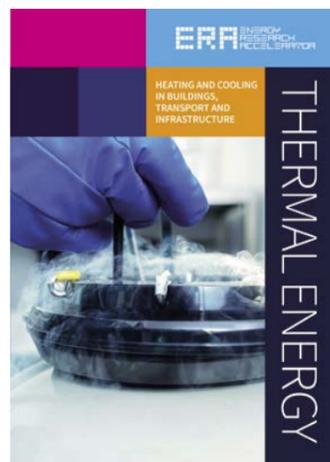
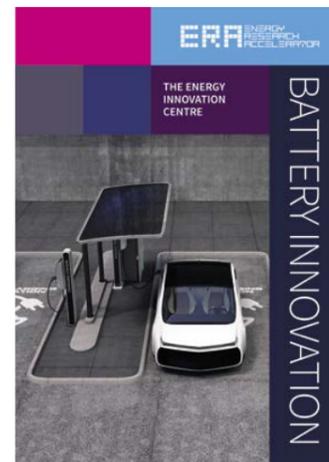
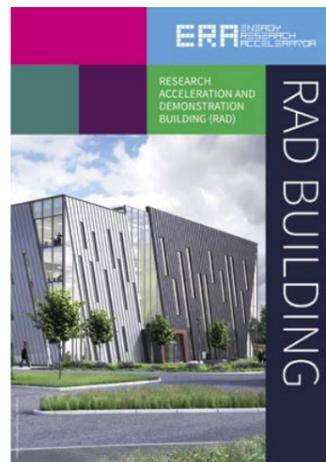
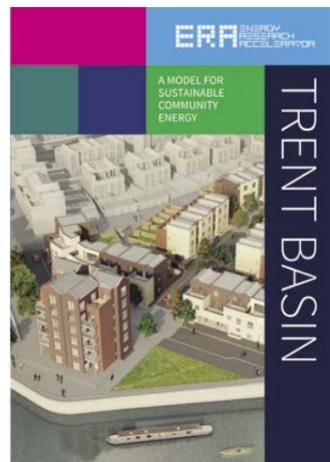
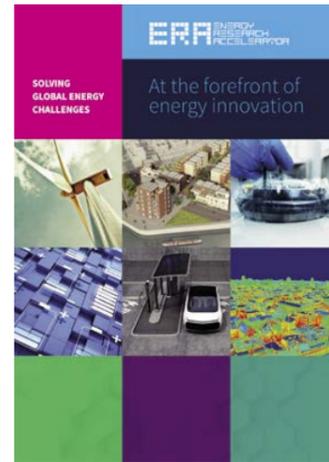
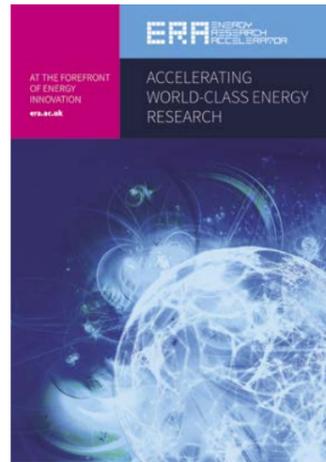
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