MIDLANDS ENGINE

REVIEW OF GREEN INNOVATION IN THE MIDLANDS ENGINE

DECEMBER 2022

ENERGY RESEARCH ACCELERATOR

CONTENTS

Front cover image: Trent Basin Nottingham, photo courtesy UK Cabinet Office.

ACKNOWLEDGEMENTS

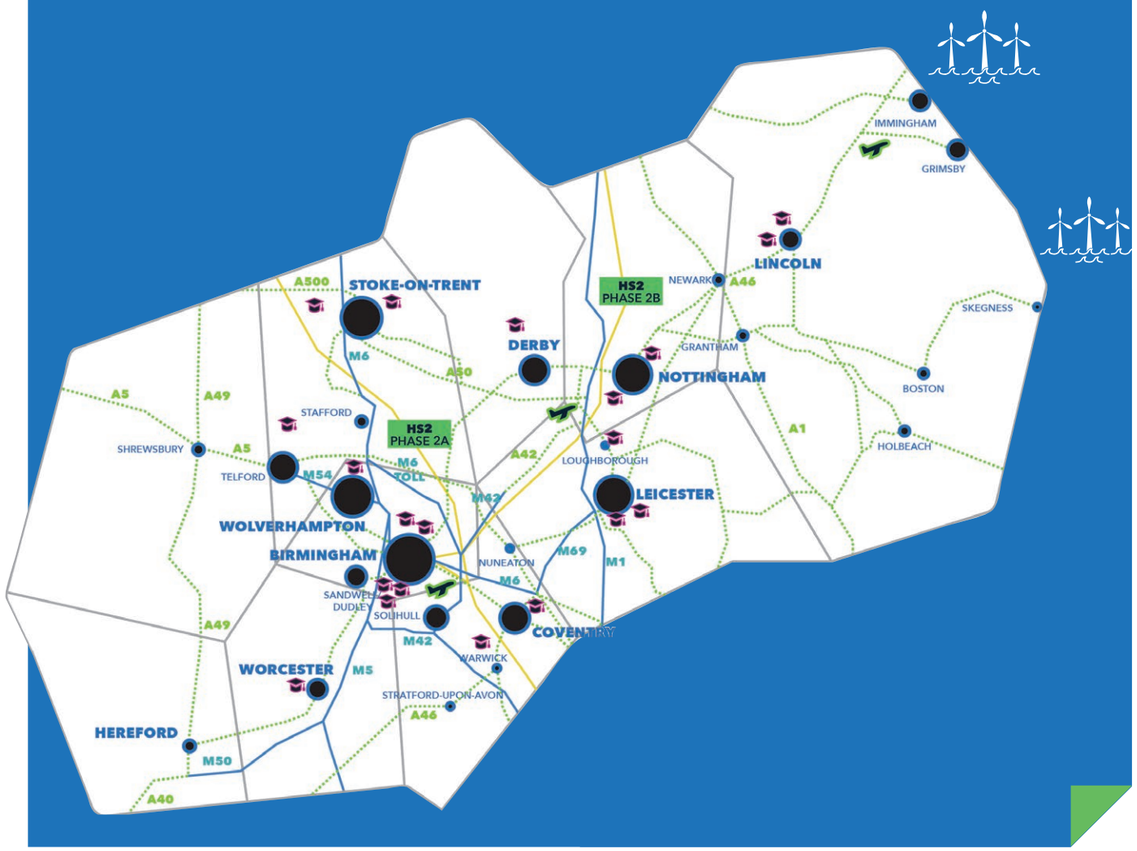
Thank you to the Energy Research Accelerator (ERA) for contributing their expertise to research and deliver this report. Thank you also to all partners who participated in one-to-one interviews and group workshops to inform the insights in this report.

Headline ambitions of the Ten Point Plan for Green Growth in the Midlands

DELIVER 196,000 JOBS

REDUCE CO_2 BY 20.8M TONNES

PRODUCE MORE THAN £24.2BN IN GVA



1 EXECUTIVE SUMMARY

The Midlands has been the engine driving the UK economy for generations, with this amounting to around £250 billion for the UK economy every year. In 2021 the Midlands Engine published the Ten Point Plan for Green Growth, an ambitious plan setting out how the Midlands Engine partnership can accelerate the region and UK towards net zero and become a leading location for low carbon investment. The plan calculates that, if Midlands Engine partners successfully deliver the collective activity set out in the plan by 2041, this will deliver more than 196,000 jobs, a reduction in CO_2 of 20.8m tonnes, and produce more than £24.2bn in GVA.

Green innovation is a key enabler of much of this collective activity, and to deliver against these ambitions, there is need for a more detailed set of actions which reflect the changing nature of the energy and sustainability landscape. Since the Ten Point Plan for Green Growth was published, the energy crisis has begun to impact Midlands citizens and business. There is now not only an urgent need to transition to low carbon energy, but also to affordable energy. The industrial base of the region has been particularly impacted by rising energy costs and without intervention there is a very significant danger of large-scale closures and job losses. But the transition to net zero also offers opportunity as new industrial and service sectors open up which have seen high levels of growth in recent years. The key is to support the current industrial community to reduce energy costs, switch to low carbon fuels and enhance efficiency whilst creating new sectors into which businesses can transition or be established. A thriving green innovation ecosystem is needed to underpin all this, but this is unlikely to happen organically and needs regional leadership and coordination at a Midlands Engine level to play a role.

The present report has surveyed the opportunities for green innovation across the Midlands and presents six recommendations for pan-regional collaborative action which could help Midlands business take advantage of the accelerating growth of the green economy.

Recommendations	
1.	Coordinate green innovation activities across the region and create a platform to showcase examples of green innovation.
2.	Establish, and seek funding for, a programme to support energy intensive businesses to decarbonise and drive down energy costs and increase efficiency.
3.	Develop an advisory and support programme to enable businesses to pivot and grow in the cleantech sector.
4.	Support the development of funded region-wide thematic innovation programmes.
5.	Advocate for new RD&I facilities for the region.
6.	Support the development of a Net Zero Skills directory, connecting the regional skills, training and degree programmes into a Midlands Net Zero Academy.

2 INTRODUCTION

The shift to low carbon is a huge opportunity for business, industry and job creation in the Midlands. In 2021 the Midlands Engine launched the Ten Point Plan for Green Growth. This recognised that economic recovery and levelling up requires collective action.

The Plan prioritised ten key areas for action:

- Green Buildings
- Clean Energy
- Net Zero Transport
- Smart Energy
- Nature's Recovery
- Green Innovation
- Blue-Green Places
- Energy Workforce
- Low Carbon Hydrogen
- Green Finance

The overarching aim is to **create 196,000 new jobs**, add **£24.2 billion GVA** and **reduce carbon emissions by 36% by 2041.**

Green innovation is really cross-cutting in that to deliver green growth, every sector will need to innovate and new sectors, such as hydrogen, will need to be established. It is this innovation, the development of new sectors, new businesses, enhanced skills and productivity which will drive much of the anticipated economic growth and carbon reductions. The aim is to foster a rich green innovation environment, supporting our world-leading inventors, entrepreneurs, leaders and researchers to develop and commercialise new ideas for the economic good of our region and nation, and for wider societal benefit. By investing now in next generation manufacturing processes and resilient supply chains, we can minimise environmental impact and resource use.

The Midlands is the undisputed manufacturing heartland of the UK. Of the 2 million people employed in England in this sector, 513,000 are based in the Midlands - equal to 11.4% of our region's total employment and a much higher percentage than England's average of 7.5%. The region's exports nearly £50 billion worth of goods each year - 20% of England's total goods exports - and the vast majority of these are from manufacturing.

The industrial and manufacturing tradition of the Midlands is both a strength and a challenge. A strength because the foundations exist for the pivot to green manufacturing, but a challenge as much manufacturing is energy intensive and high in carbon emissions. Manufacturing in the Midlands therefore needs curated support to become both energy efficient and low carbon, otherwise risking the loss of this historic legacy.

Midlands – heartland of the UK manufacturing sector

England's manufacturing workforce is **2 million**

513,000 **are based in the Midlands**

11.4% of employment in the Midlands Engine

The region exports nearly

£50 billion

of goods each year

20% of England's total goods exports

2.1 The Midlands green innovation ambitions

Green innovation forms one of three 'Enabler' themes in the region's Ten Point Plan for Green Growth. To enable green growth in the Midlands, new green innovation as well as the deployment and coordination of new green technologies and services will be needed going forward.

To deliver this, the Ten Point Plan lists four actions:

1. Develop an innovation pathway to promote sustainable technologies and enable the development of system level demonstrators.
2. Support the mapping and development of green and low carbon manufacturing and supply chains across the Midlands.
3. Review rapidly the Midlands energy R&D infrastructure to support commercial development and investment.
4. Examine pan-regional opportunities for circular economies.

2.2 Purpose of review

The present review builds upon the threads in the Ten Point Plan to make concrete recommendations for the acceleration of green innovation across the Midlands with the following aims:

- Identify opportunities for the region to accelerate green innovation and drive green innovation investment.
- Provide an evidence base for discussions with government on regional strengths, where the opportunities align with future ambitions.
- Recommend collaborative activities to strengthen green innovation in the region.

3 APPROACH

The review was performed collaboratively with the Midlands Engine Observatory and conducted by the Energy Research Accelerator. There were three elements to the process, as set out below.

3.1 Desktop review

A review of existing reports and data was performed to map the Midlands regional context, strengths, organisations and track record. This covered the following areas: the business ecosystem, innovation organisations and case studies, the R&D ecosystem and the skills base. This review then fed into the discussions with Midlands Engine innovation stakeholders through a series of in-depth interviews.

3.2 Interviews

A series of interviews were held with organisations which support green innovation in the energy and manufacturing sectors across the Midlands. A series of standard questions were developed based on the desktop review.

Organisations interviewed	Key questions asked
• Manufacturing Technology Centre • Connected Places Catapult and High Value Manufacturing Centre • Universities including representatives from both Midlands Innovation and Midlands Enterprise • Horiba-MIRA • Nuclear AMRC • Energy Systems Catapult • Warwick Manufacturing Group • Sustainability West Midlands	• What role can you play in green innovation? • What are the key areas we should innovate in? • What are the areas of green innovation we should amplify as a region? What should the region be doing on green innovation? Which sectors should be the key areas of focus? • How should we encourage green start-ups, spin outs and growth? • How should we encourage connecting innovation between collaborators? How can we improve collaboration? • What actions should the region take to drive green innovation?

Table 1. Organisations who were consulted.

3.3 Workshop

The conclusions from the discussions and interviews were then combined with the output from the initial review to shape a series of conclusions regarding priority areas. These recommendations were shared with regional stakeholders invited to an online workshop. Input from that workshop was used to further refine the recommendations. The present report contains the final conclusions and recommendations. These recommendations are targeted at a Midlands Engine scale, recognising the role the Midlands Engine secretariat can play to coordinate and influence partner activity at this level.

4 OVERVIEW OF THE MIDLANDS ENERGY AND LOW CARBON TECHNOLOGIES SECTOR

The Midlands has tremendous strengths in the energy and low carbon technology sectors which provides a strong platform for future growth:[1]

- The Midlands is home to **22% of England's energy and low carbon businesses.**
- **£11.6 billion of Midlands Engine GVA** is attributed to energy and low carbon technologies, **4.8% of the whole economy,** compared to 4.1% at UK level.
- **23,005 businesses** work in this sector, **6.0% of all businesses in the area** – a higher percentage than the UK average of 5.7%.
- **106,990 people** work in this sector, **2.4% of overall employment** – higher than the national average of 1.8%.
- Every year **more than £2.5 billion of capital investment** is made in energy technologies and infrastructure (excluding buildings and transport) across the Midlands.
- There are **more than 10,000 companies** working in the energy sector supply chain across the Midlands, **employing over 56,000 people.**
- Small and micro businesses (with under 50 employees) make up **98% of businesses in the Midlands** (375,515 out of 383,120). **SMEs make up 98.5% (22,655)** of all energy and low carbon businesses.

[1] ONS Gross Value Added (Balanced) 2022, ONS UK Business Counts 2022, ONS Business Register and Employments Survey 2022

5 THE FUNDING LANDSCAPE TO SUPPORT GREEN INNOVATION

Access to funding to allow business ideas to develop is vital to allow companies to scale-up and grow. Appropriate finance will depend on the stage that the idea or business is at. Key funding will vary - from government grant applications at an early stage, to angel investors and venture capital funding as ideas develop, and finally to more traditional bank loans as businesses look to significantly scale-up.

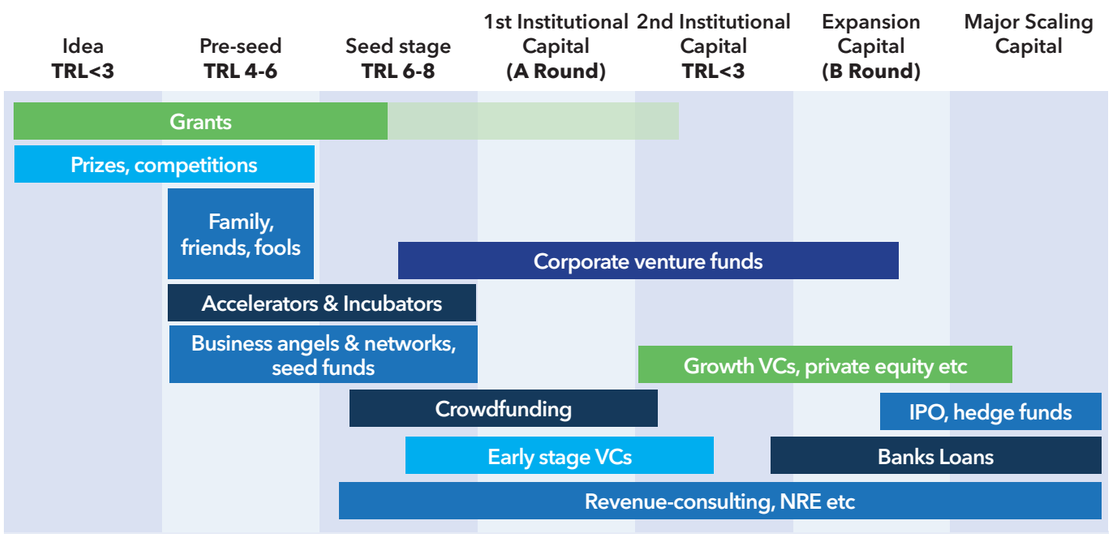


Figure 1. Sources of funding during the start-up process (Source: Octopus Investments, 2022)

5.1 The role of the UK Government R&D funding

Innovation funding enables commercial organisations and the civic and academic sectors to collaborate and innovate, often allowing innovative technologies and services to rapidly grow and scale-up with an associated increase in jobs.

UK Research & Innovation (UKRI) is the main government body that oversees research and development spend in the UK. The government has an ambition to increase R&D spend to 2.4% of GDP by 2027. This amounts to a £2.3bn annual increase in R&D spend, providing the potential to create tens of thousands of jobs. If this growth is realised, then it provides a substantial platform for the Midlands Engine to build upon.

The main funding body at the commercialisation end of research and innovation development is Innovate UK, which sits within UKRI and supports a large number of projects each year with a particular focus on supporting businesses. In UKRI's recently published corporate plan,[2] they set out their aim to increase Innovate UK's spend over the next three years by 66%, with a budget of more than £1 billion a year by 2024-25. Other government funders, such as the Engineering and Physical Sciences Research Council (EPSRC), provide funding for earlier stage research primarily to the university R&D sector.

[2] UK Research and Innovation, UKRI Strategy 2022-2027, March 2022

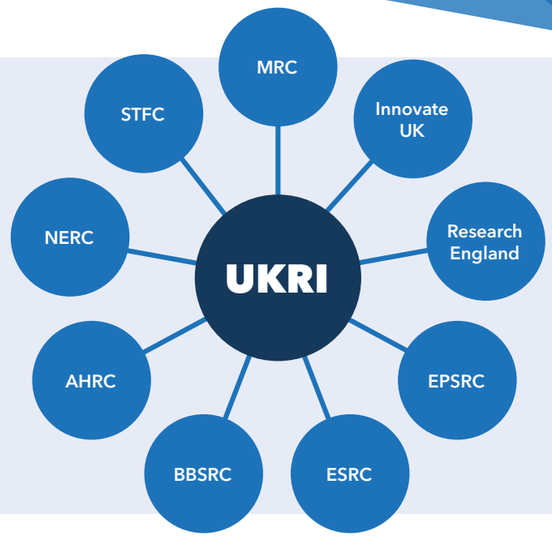


Figure 2. Key funding bodies that make up the UKRI group (adapted from Sweeney, Research England)

Organisations are:

Medical Research Council (MRC), Engineering & Physical Sciences Research Council (EPSRC), Economic & Social Research Council (ESRC), Biotechnology & Biological Sciences Research Council (BBSRC), Arts & Humanities Research Council (AHRC), Natural Environment Research Council (NERC), and Science & Technology Facilities Council (STFC).

The Department for Business, Energy & Industrial Strategy (BEIS), the Office of Gas and Electricity Markets (OFGEM) and Department for Transport (DfT) also provide funding in this area targeted at specific programmes which support their strategic agendas.[3] For example, BEIS has a current £1 billion Net Zero Innovation Portfolio (NZIP) which aligns with the UK Government's Ten Point Plan and is focused on ten priority areas, including:

- **Future offshore wind**
- **Nuclear advanced modular reactors**
- **Energy storage and flexibility**
- **Bioenergy**
- **Hydrogen**
- **Homes**
- **Direct air capture and greenhouse gas removal (GGR)**
- **Advanced carbon capture, usage and storage (CCUS)**
- **Industrial fuel switching**
- **Disruptive technologies**

OFGEM has the Strategic Innovation Fund (UK SIF) programme in collaboration with Innovate UK. This £450m fund is aimed at the Electricity System Operator, electricity transmission, gas transmission and gas distribution sectors and aims to find and fund ambitious, innovative projects with the potential to accelerate the transition to net zero.

5.2 Investment funding

Many companies which are looking to grow, either seek debt or equity funding to support growth in their business. An ecosystem of organisations able to support businesses ensures opportunities for growth and jobs are maximised. Key organisations in this area include the following:

- **British Business Bank:** is a government-owned, but independently managed, business development bank focused on smaller businesses. They support the UK's transition to a net zero economy. They don't lend or invest directly but work with over 130 partners such as banks, leasing companies, venture capital funds and web-based platforms. They oversee the Midlands Engine Investment Fund which the government committed a further £400m towards in 2021.
- **Venture capital organisations and angel investors:** There are a number of private venture capital and angel investors active in the net zero space in the UK. For example, at the larger end Octopus Investment invests in start-ups looking to rapidly scale up. At the smaller end there are individual angel investors investing in individual technologies and businesses.

Having an active and engaged group of such investors in the Midlands region will be important to support businesses needing access to investment as they scale up.

[3] These programmes are often in collaboration with Innovate UK and supported by the Knowledge Transfer Network who provide matchmaking services.

6 THE CURRENT REGIONAL INNOVATION ASSETS AND ORGANISATIONS

A number of green innovation organisations already exist in the region. These can roughly be divided into innovation-led organisations such as catapults, research technology organisations and universities; major organisations who are innovating in the net zero or green space typically as part of their overall strategic plans; and innovative SMEs with a green growth aligned focus that have developed or operate in the region.

6.1 Innovation assets

The Midlands has a number of innovation assets, which if well-coordinated could accelerate green innovation. These can be divided into organisations and locations.

6.1.1 High Value Manufacturing Catapult (HVMC)

The HMVC has five separate components, three of which are in the Midlands. The Manufacturing Technology Centre (MTC) is based at Ansty Park, Coventry, Warwick Manufacturing Group (WMG) at the University of Warwick and the Nuclear Advanced Manufacturing Research Centre (NAMRC) in Derby, with a HQ in Sheffield. These centres support manufacturing traditionally in the aerospace, automotive and nuclear sectors but have cross-sector capability allowing them to reorientate as sectors and demands evolve. Their focus has been driving innovation in manufacturing within UK industry and they as a key component for developing green manufacturing.

6.1.2 Energy Systems Catapult

Based in Birmingham, the Energy Systems Catapult has a range of expertise which extends from energy markets, to energy data and systems, to deployment of large-scale energy solutions, to a living laboratory, and finally to an SME support programme. They have co-developed tools for local authorities and helped develop the Smart Systems and Heat programme. This is a one-stop-shop to support the national energy transition, with opportunities to maximise the benefits regionally.

6.1.3 Universities and colleges

Research, development and innovation often starts inside universities. Universities make applications to UKRI for funding to perform fundamental research either alone or in collaboration with industry. The region possesses a strong R&D and innovation portfolio, with current R&D programmes focusing on areas such as battery developments, software for connected and autonomous vehicle-related (CAV) analysis, sustainable energy sources, and fuel cell technologies. These programmes are supported by universities and organisations that promote public-private collaboration. The Midlands has a strong reputation for engineering and manufacturing excellence; the transition to a low carbon economy will benefit from both inherited manufacturing and R&D capabilities.

Innovation from universities often leads to spin-out companies, and they support innovation through access to facilities and expertise. The second key element universities provide is skills development, from apprenticeships to PhDs and continuing professional development (CPD) essential to successful business growth. The regional universities are coordinated through either Midlands Innovation and the Energy Research Accelerator, or via Midlands Enterprise Universities. It is this coordination which provides the Midlands with a useful platform lacking in other regions.

Figure 3. Midlands Engine universities

6.1.4 Horiba-MIRA

Based in Nuneaton, Horiba-MIRA provides a platform for innovation in the automotive sector which most recently is focusing on low-carbon vehicles, particularly hydrogen. It has a range of facilities including testing and validation and a large test track for vehicle development. The site has become the location for a number of sector-leading businesses to base themselves to accelerate technology development, particularly in the hydrogen vehicle sector. For example, the hydrogen vehicle company TEVVA has recently located its research centre here.

6.1.5 Energy Capital

Coordination organisations such as Energy Capital (and similarly Sustainability West Midlands) are key in creating regional coherence. Energy Capital is embedded within the West Midlands Combined Authority and drives and links a number of programmes including those associated with the UKRI Prospering from the Energy Revolution programme. These include Regional Energy System Operator (RESO), Repowering the Black Country and Zero Carbon Rugeley (led by EQUANS). Energy Capital has developed the concept of Energy Innovation

Horiba-MIRA's proposed Hydrogen Technology Hub based on the A5, Nuneaton

Zones, which are focused geographic areas for developing the energy transition with a platform for bringing partners together with shared objectives. There are currently five Energy Innovation Zones across the West Midlands. These zones are platforms for aggregating innovation and then diffusing it to the wider Midlands economy.

6.1.6 Power stations and freeports

There are a number of distinctive locations across the Midlands which present opportunities for clustering innovation activities. The Energy Innovation Zones are one platform, but the coal power station sites of the Midlands are a key opportunity for re-energising innovation and manufacturing. Sites such as Drakelow and Ratcliffe are already set to host energy-from-waste plants with the potential for business clusters.

The two Midlands Freeports can play an important role in driving green innovation.

Freeports at East Midlands Airport and the Humber are expected to "create hotbeds for innovation by focusing on private and public sector investment in research and development; by being dynamic environments that bring innovators together to collaborate in new ways; and by offering spaces to develop and trial new ideas and technologies. This will create new markets for UK products and services and drive productivity improvements, bringing jobs and investment to Freeport regions."[4] There are a range of other Midlands opportunities, including business parks, which need to be fully integrated into these developments. Most recently, UK Government has invited local place leadership to submit bids to co-design future Launchpad investment programmes, providing up to £7.5m of targeted support for business-led innovation projects and wrap-around support.[5] Several Midlands Engine locations have made bids for selection.

[4] Department for Levelling Up, Housing and Communities, Freeports programme monitoring and evaluation strategy, May 2022.
[5] Innovate UK, Partner selection for future Launchpads (website)
[6] HM Revenue & Customs, Maps of the Successful English Freeport Bids, 2021

The Humber Freeport zone[6]

Figure 4: Characterisation of Midlands Engine-based organisations and sites and how they link into the innovation landscape. The national organisations that have an influencing role in the region are shown on the right-hand-column.

High Value Manufacturing Catapult			
Manufacturing Technology Centre (MTC)	Warwick Manufacturing Group (WMG)	Manufacturing expertise, SME support programmes	Nuclear AMRC (Derby)

Energy Systems Catapult		
Expertise in energy systems and policy	Support for local authorities and business	SME support programmes; Energy Launchpad

Universities and colleges				
Energy Research Accelerator (ERA)	Midlands Enterprise Universities	SME support programmes	R&D expertise and facilities	Skills and training

Horiba-MIRA			
Support for automotive sector	Test track and test facilities	Focus on hydrogen and electric	Innovation centre

Energy Capital				
Embedded in WMCA	Projects: NZN, RESO, Rugeley	Energy Innovation Zones	Tyseley Energy Park	Innovation Accelerator pilot

Power stations and freeports				
Freeports: East Midlands and Humber	Ratcliffe: Emerge Energy-from-Waste Development	West Burton: STEP Fusion Plant	Rugeley: Zero Carbon Rugely	Drakelow: Energy-from-Waste Development

Other regional innovation-support organisations				
Sustainability West Midlands	Midlands Net Zero Hub	Local Enterprise Partnerships	East Midlands Development Corporation	Midlands Connect

National organisations based outside the region
Connected Places Catapult
Nuclear AMRC (HQ in Sheffield but with R&D facility in Derby)
Offshore Wind Catapult (HQ in Glasgow but with O&M Centre of Excellence at Grimbsy)
UKRI, Innovate UK and EPSRC
National Nuclear Laboratory
National Physical Laboratory

6.2 Major industrial organisations with green innovation capacity operating in the region

There is a significant base of organisations operating, or based, in the region that are active in the green innovation space. These include (not an exhaustive list): Alstom; Ansaldo; Arup; Aston Martin; Atkins; Baxi; Birmingham Airport; Boots; Cadent; Caterpillar; Cenex; The Cooperative Group E.ON; EDF; Engie; EQUANS; HS2; Intelligent Energy; JCB; Horiba-MIRA; LEVC; MAG-East Midlands Airport; National Grid; Orsted; Philips66; Porterbrook; Raleigh; Rolls-Royce; Severn Trent; Siemens Energy; Tarmac; Toyota; Uniper; UPS; Vaillant; Vivarail; Western Power Distribution; Worcester Bosch; WSP.

The following is a limited set of examples that illustrate activities within the region being led by industry which will have an impact on wider innovation opportunities.

Uniper is exploring a range of lower carbon energy projects, including the development of an energy-from-waste facility at its Ratcliffe-on-Soar power station site (as the coal-fired power station closes in line with government policy by 1 October 2025). Known as the **East Midlands Energy Re-Generation (EMERGE) Centre,** the proposed facility would help meet the UK's ambitions to reduce waste and manage its impact on the environment, reducing CO_2 emissions, and meet landfill diversion targets. **EMERGE** is part of a wider vision for Ratcliffe to move towards becoming a zero carbon technology and energy hub for the East Midlands.

Jaguar Land Rover (Coventry & Solihull) has been pioneering the production of electric vehicles. This has helped fuel demand for regional battery manufacturing ambitions, including construction of a West Midlands Gigafactory and the development of plants for the recycling and re-manufacture of batteries, electric motors and generators. Meanwhile, **Voltempo** (Birmingham) is developing the next generation of rapid EV chargers, while **Vivarail** (Warwickshire) has certified the UK's first battery-powered train. In hydrogen transport, companies such as **Toyota** (Derbyshire) supply hydrogen cars with the potential to develop hydrogen trucks; **FAUN Zoeller** (Redditch) are introducing hydrogen refuse collection vehicles while **Porterbrook** (Derby) and **Alstom** (Derby) could help introduce hydrogen trains. **JCB** (Staffordshire) meanwhile have also developed hydrogen-powered construction vehicles.

Rolls-Royce have generated new opportunities in sustainable flight and sustainable fuels. Moreover, their ambition around next generation nuclear energy, including small modular nuclear reactors (SMRs), provides an opportunity for the development of innovation in manufacturing and as well as the deepening of regional supply chains in this sector. The creation of a new UK nuclear fusion energy sector will similarly be a platform for regional growth, especially given the recently announced STEP fusion reactor will be sited at West Burton in Nottinghamshire. The UK has attracted a number of fusion companies due to the level of ambition in this sector.

Impression of potential re-development of the Ratcliffe-on-Soar power station site (Source: East Midlands Development Corporation, 2022)

The development of low carbon heating solutions is also being led by energy businesses. This is taking place at both a city scale, such as **EQUANS**'s district heating system in Birmingham, and on a domestic level with companies such as **Worcester-Bosch, Baxi** and **Vaillant** developing next generation heat technologies and other companies like **E.ON** developing new customer services and products. **Siemens** have also delivered an exemplar smart energy system at the **University of Keele.**

6.3 Innovative SMEs already operating in the region

There are a number of SMEs already active in the region's green innovation space. These give an understanding of the potential for other SMEs to develop in the region. A few examples are highlighted below:

Cheesecake Energy – an SME spin-out from the University of Nottingham which has successfully obtained £3.5m in investment to develop energy storage technologies to support the UK's energy system.[7]

Grid Edge – founded in 2017 by three friends and colleagues from Aston University's EBRI research institute. It aims to change the way people use energy by putting commercial energy consumers at the heart of the changing energy system, empowering them to become active and intelligent participants in the battle to combat climate change. The company was awarded Tech Start-up of the Year in the Midlands by KPMG in 2019.

Intelligent Energy – a spin-out of Loughborough University, it has been active in fuel cell development for around 30 years. They have a range of fuel cell products for the automotive, UAV and flight sectors and operate in international markets including Japan, the United States and South Korea.

ITM Power and Motive – a Sheffield-headquartered company with over 20 years working on developing electrolysers. Early products have been established at the University of Birmingham, Nottingham and more recently Keele University. In addition, the recently spun-out company, Motive, now own and operate the hydrogen refuelling station at Tyseley Energy Park.

Motive's refuelling station at Tyseley Energy Park which is designed for both cars and heavy-duty vehicles and produces 1 tonne/day of green hydrogen and is certified as over 99.999% pure hydrogen.

[7] UKTech.News, Nottingham spinout Cheesecake Energy sells £3.5m slice to investors (website)

The Cheesecake Energy team

Kew Technology – uses proprietary technology to recycle waste and biomass-based feedstocks into advanced energy vectors. Over the last 10 years they have gone from development to deployment with a full commercial product demonstrator (>£35m).

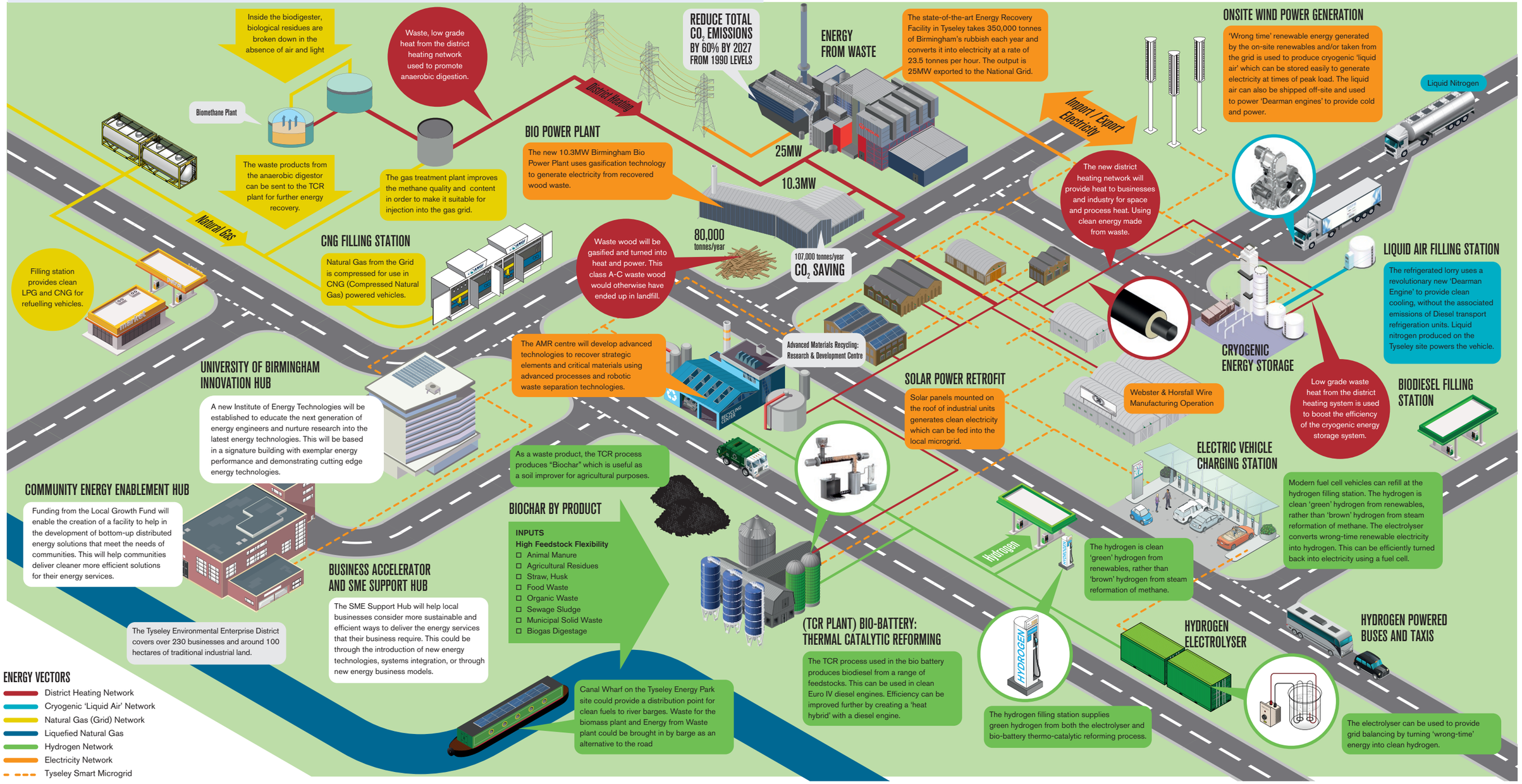
Tyseley Energy Park – the Park belongs to the family-run SME, Webster and Horsfall, who have a long heritage in metal processing. However, in the last ten years, they have pivoted their business park based in East Birmingham to become a flagship Energy Innovation Zone.

Aqsorption Ltd – a Nottingham-based SME that has become an expert in small-scale green hydrogen production. Funding from The UK Atomic Energy Authority enables their technology to be used for hydrogen isotope separation in the fusion industry and D2N2 Low Carbon Growth Fund has funded the first EU farm-based Anaerobic Digester (AD) to inject green hydrogen and enhance the AD process.

Maeving – electric motorbike company which has recently received £1m funding from the Midlands Engine Investment Fund.

Aurrigo – a leading international provider of transport technology solutions based in Coventry. The Group designs, engineers, manufactures and supplies OEM products and autonomous vehicles to the automotive, aviation and transport industries.

Figure 5. Schematic of Tyseley Environmental Enterprise District showing the elements that make up the energy innovation zone located in East Birmingham



7 IDENTIFYING AND SUPPORTING KEY INNOVATION SECTORS IN THE REGION

The net zero transition and the integration of sustainability and circular economy principles will allow the development of a range of new sectors, impacting across the Midlands region. The Midlands has different levels of established expertise and leadership which will impact how readily business will be able to drive the transition. There are some areas where the Midlands is well-placed to take a leading role and should prioritise investment and support. The Midlands historic strength in manufacturing makes it well-suited to be the heartland of green manufacturing.

7.1 Key green innovation sectors in the region

Sectors where coordinated regional activity bringing together stakeholders with regional and national government support could accelerate growth and development.

7.1.1 Smart energy and digital systems

There are a series of smart energy demonstrators in the region which include the SEND project at Keele, the Regional Energy Systems Operator (RESO) project at Coventry, the smart campus at University of Birmingham, and the Nottingham and the Nottingham Trent Basin demonstrator. Indeed, the Midlands Engine is the second-best performing region in England for smart energy activities due partly to a higher than average workforce in the sector. The Midlands has also been a pathfinder for 5G demonstration and rollout.[8]

Potential impact:

Maximising smart energy interventions in the region **could save £68bn by 2050, generate £1.5bn GVA** for the regional economy, **generate £600m in exports, support** or create **over 7,000 jobs per year,** and **reduce CO_2 emissions by 106,000kt by 2050**.[9]

7.1.2 Zero carbon transport

The presence of Jaguar Land Rover and Toyota in the Midlands coupled with coupled with Warwick Manufacturing Group, Horiba-MIRA, Advanced Propulsion Centre, and UK Battery Industrialisation Centre means there is an established base in the region to build on. Midlands rail companies are delivering battery and hydrogen alternatives, while construction companies like JCB develop new hydrogen construction vehicles.

Potential impact:

Electric vehicles and batteries manufacturing **could support an additional 11,500 jobs by 2050 and reduce greenhouse gas emissions** from the region's transport sector.[10]

[8] Midlands Engine, Smart Energy - An Energy System for the 21st Century, November 2022.
[9] Midlands Engine, Smart Energy - An Energy System for the 21st Century, November 2022.
[10] Midlands Engine, Midlands Engine Manufacturing Opportunities, November 2021.

7.1.3 Recycling and the circular economy

The Midlands has a need to develop waste processing capability. Many of its energy-from-waste plants are old and are reaching the end of life. Coupled with the decommissioning of old coal power stations with their robust grid connections, there is the opportunity for the redevelopment of these power stations sites with energy-from-waste plants and businesses clustered on the site. The power and heat from the energy-from-waste plants then can power the businesses, providing access to potentially low-cost heat and electricity. Integrating into this ecosystem next generation recycling and reprocessing technologies, such as plastic, lithium-ion battery or rare earth magnet recycling would be optimal.

Potential impact:

New jobs, **reduction in waste going to landfill** and **reduced greenhouse gas emissions** associated with energy production.

7.1.4 Nuclear and related industries

The UK Government's investment in nuclear energy technology is in excess of £1 billion. This ranges from support for small modular nuclear reactors (SMRs), to advanced modular reactors (AMRs), through to nuclear-related fusion. The Midlands is home of the Rolls-Royce nuclear reactor programme, with the production of reactors for the UK submarine fleet and now the UK SMR programme. There are a number of large nuclear companies in the region including Alsaldo Nuclear, Cavendish Nuclear, Atkins and the Nuclear Advanced Manufacturing Research Centre (NAMRC) located in Derby (HQ Sheffield). Development of regional supply chains and skills development could be proactively coordinated through the NAMRC and partners. There are opportunities for siting smaller reactors within the region to support industrial clusters and hydrogen generation.

The STEP fusion programme also presents opportunities within the region with West Burton in the Midlands the recently announced site for the prototype fusion reactor.

Potential impact:

New jobs and net zero energy production. The Rolls-Royce consortium believes their SMR programme can support **up to 40,000 jobs** with each SMR capable of **powering 450,000 homes.**[11]

[11] Department for Business, Energy & Industrial Strategy, Advanced Nuclear Technologies, March 2022.

7.1.5 Energy storage

The Midlands heartland has few electricity generation assets following the closure of its main coal-based power stations and much of the region is far from coastal sites in the UK, where offshore wind and large-scale nuclear generation will dominate. Management of the future energy system with intermittent generation will require large amounts of storage – heat, electricity and hydrogen. Old coal power station sites, with their existing grid connections, are obvious sites for the deployment of grid-scale energy storage plants.

The Midlands universities have internationally-leading expertise in the development of both thermal and electrical energy storage which are well-set for scale up and integration into the energy system.

Potential impact:

Enhance net zero energy production. The amount of grid **energy storage** is likely **to be tens of gigawatts.**

7.1.6 Heat and net zero buildings

The decarbonisation of the UK's housing stock of >20 million homes is the biggest challenge in reaching net zero, accounting for ~20% of the UK's CO_2 emissions. The Midlands has some of the most challenging locations with run down homes and high levels of fuel poverty.

There is a need to upgrade insulation to drive up EPC levels and a transition away from high cost natural gas boilers. The Midlands has some of the UK's leading heating manufacturers including Baxi, Vaillant and Worcester-Bosch. There have been some pioneering deployments of net zero homes in the Midlands including the Energiesprong demonstration in Nottingham, which is seen as a national exemplar.

The Midlands is well placed to drive this sector, as recognised through the Midlands Engine-supported proposal to develop a Midlands-based National Centre for Decarbonisation of Heat.

Potential impact:

Decarbonising housing and **reducing fossil fuel dependence** for consumers. Fuel poverty has a strong dependence on the price of heating and gas.

A transition to low carbon heating **will reduce fuel poverty levels** which are some of the UK's highest in the Midlands.

Figure 6. Examples of emerging sectors. There are opportunities for the Midlands Engine to position itself strongly to take a leading role in their development.

Smart energy and digital systems			
Smart devices	Smart buildings	Smart networks	Carbon and cost optimisation
Integrated sensors and forecasting		Smart tariffs and energy use	

Nuclear energy		
SMR	AMR	Fusion
GDF	Site development	

Energy storage	
Electrical storage	Thermal storage
Hydrogen storage	Systems integration

Customers and consumers			
Heat as a service	Smart tariffs	Energy efficiency	Community energy
Green mobility	Green jobs	Living labs	

Heat & net zero buildings	
Heat pumps	District heating
Hydrogen boilers	Thermal efficiency
Housing retrofit	Net zero construction

Green energy manufacturing	
Electrolysers and fuel cells	Batteries and vehicles
Green construction	Wind turbines
Heat pumps and boilers	Nuclear components

Green energy generation	
Solar	Onshore and offshore wind
Green gas combustion	Geothermal and mine water

Energy networks
Hydrogen and biogas distribution
Electric grid reinforcement
Smart electric and heat grids

Direct air capture and CCUS		
Direct air capture technologies	Carbon capture and utilisation	Carbon offsetting
CO_2 storage	Carbon integration into materials	Vertical farms and agriculture

Low carbon transport
Electric vehicles and batteries
Hydrogen heavy vehicles and trains
E-mobility and light rail
Net zero aviation
Charging infrastructure
Sustainable fuels

Recycling and circular economy
Plastics
Batteries and magnets
Energy and fuels from waste
Pyrolysis, gasification, anaerobic digestion
Biochar and agriculture
Design for de-manufacture and re-manufacture

Hydrogen
Hydrogen for heat
Hydrogen for transport
Hydrogen for industry
Green hydrogen generation
Distribution and storage

7.1.7 Hydrogen

The Midlands has a large industrial cluster around the Humber which has potential to develop blue and green hydrogen generation and utilisation. Moreover, the Humber has access to 80% of the UK's licensed CO_2 storage capacity, and it is predicted the cluster could meet 30% of the UK government's hydrogen production target by 2030.[12] Smaller industrial clusters also exist with potential to use hydrogen such as around the Black Country. There are also a number of distinctive assets demonstrating regional leadership including the HyDeploy hydrogen blending programme at Keele University, the ITM Motive 1 tonne/day green hydrogen facility at Tyseley Energy Park in Birmingham, and the new hydrogen refuelling station being developed in Nuneaton at the Horiba-MIRA facility. The Midlands also has companies who are well placed to take advantage of this emergent sector like Intelligent Energy and Adeland (fuel cells) and Toyota (hydrogen vehicles). Coordinated programmes, such as HyDEX, create a great platform for accelerating this sector. Hydrogen will primarily be used for decarbonisation of heavy transport, trucks and trains, and decarbonisation of the manufacturing sector.

Potential impact:

Development of an ecosystem of hydrogen related businesses. **Reduced reliance on fossil fuel energy** production. Development of a **manufacturing base capable of transforming the UK's nearly 120,000 heavy trucks to low carbon.**[13]

12 Humber Industrial Cluster Plan, The Humber: A 2030 Vision for Industrial Decarbonisation, September 2022.
13 Statista, Number of licensed heavy goods vehicles in Great Britain from 2010 to 2020 by weight class (website)

7.2 Targeting and supporting sectors

To support green innovation, targeted activities need to focus on four areas. These are set out below, with some indication of the type of intervention required.

7.2.1 Decarbonisation of energy intensive industry

Many of the region's businesses are energy-intense manufacturers. These are based around industries like the metal forming and ceramics sectors and have dense populations like the Black Country, Stoke and Staffordshire and the Humber. With rising energy costs, there are coinciding needs to reduce energy costs and decarbonise. Many of these businesses are also traditional and family-run without the breadth of expertise to modernise rapidly and transition to energy efficient, low carbon manufacturing processes or even to realign the business to other product lines or sectors. For those companies that are using gas there will be a need to transition to hydrogen or electrical induction processes and to source affordable energy. There are opportunities to think as a collective of businesses, such as around the development of an energy-from-waste or biomass plant, or procuring power through a power purchasing agreement (PPA) collectively. There is also need for support around the optimisation of industrial processes and how waste heat captured from manufacturing can either be sold into heating schemes or alternatively repurposed back into manufacturing. Again, there may be a need for symbiosis, with lower grade heat being fed into processes well matched to the heat grade.

A dedicated programme to support businesses in this sector is urgently needed to avoid a very significant wave of closures.

7.2.2 Sector and business pivoting

The Midlands Engine contains a rich manufacturing heritage. Famously, Birmingham was once the city of a thousand trades. The impact of Covid and the transition of technology and markets means that there is constant flux in the sector. The downturn in the aviation and automotive sectors has impacted the Midlands considerably and there is a need for complete supply chains to reconfigure. The green technology and cleantech sector is experiencing strong growth and pivoting to cleantech is an attractive proposition for established businesses. To do this, there is a need to support businesses through: understanding the cleantech sector, reskilling and retraining, manufacturing advice, facilities for test and validation, access to finance to invest to redevelop the business, and also reconfiguration of supply chains.

An advisory and support programme to enable businesses to pivot and grow in the cleantech sector is needed.

7.2.3 Business support and coordination

For businesses already in the sector, there is a need to support their development from the inception of the business through the pre-revenue stages to final commercial viability. This requires access to expertise, facilities, finance, market insights and market testing, IP development and patenting access to incubation facilities and test and validation capability. There are many regional support programmes and navigating them is complex, hence signposting and handholding between organisations is important. Another key ingredient is networking and the facilitation of networking opportunities.

A Midlands-wide green innovation business support and networking programme would help advance business development and growth.

7.2.4 New low carbon sector development

Some sectors associated with emerging cleantech are so new that very little support infrastructure exists, and there is a need for coordinated activity to establish all of the components required to ensure success. Hydrogen-fuelled transport is a good example of this as there is a need to establish the refuelling stations simultaneously with the vehicles as one without the other is not viable. This market building requires coordinated development of the consumers with all elements of the supply chain and assembly and sales and services. The HyDEX project is an example of a coordinated activity to support a sector development. A coordinated approach would allow the Midlands to take a leading role in new areas of industrial development. Smart energy

systems would be a good example of where such an opportunity might lie, especially given the Midlands is the second-best performing region in England for smart energy activities.[14]

The development of a series of Midlands wide projects such as HyDEX to support sector development in key cleantech areas would accelerate green innovation in the Midlands.

7.3 Encouraging collaboration and innovation

There is enormous potential if the untapped capability within the Midlands can be harnessed. As described, the regional innovation support organisations have a fundamental role to play in terms of developing the new cleantech sectors and ensuring the integration of business and industry. Coordination and a shared vision and purpose will be key at a Midlands Engine level.

[14] Midlands Engine, Smart Energy - An Energy System for the 21st Century, November 2022.

Figure 7. Summary of the four sectors which require support and development in order to achieve green innovation.

Decarbonisation of energy intensive industry				
Low cost energy	Energy storage and energy efficiency	Clustering and symbiosis	Investment capital and finance	Switching from high to low carbon fuels

Business support and coordination				
Access to facilities and expertise	Networking and networks	Signposting to support and programmes	Investment capital and finance	Business development programmes
Access to incubators and demonstrators				

Sector and business pivoting				
Product development support	Test and validation facilities	Training and skills development	Manufacturing support and advice	Investment capital and finance
Market awareness and minimum viable product development		Integration into supply chain	Business development programme	

New low carbon sector development				
Regional strategy and priorities	Investment prioritisation and support	Large OEM lead	Clustering and coordination	Competitor and regional advantage analysis
Coordinated skills development across all levels	Alignment with markets – market building	Coordination of supply chain development	Defined standards and verification processes	

The present review shows there are gaps in the innovation process in terms of progressing from an R&D stage to the commercialisation stage. There are also vulnerabilities associated with public policy and the current regulation framework: lack of clarity in the use of hydrogen, long and complicated licences for electricity and gas supply, and grey areas for the use of sustainable CO_2).[15] By connecting the regional assets to national programmes and organisations, it is possible to create a coherent Midlands-wide supporting framework for green innovation to help unlock the region's green innovation potential.

By connecting these assets with business and industry we can harness the green innovation potential of the region. A green innovation ecosystem is required with a common purpose, signposting, networking and support programmes.

[15] Midlands Engine, Midlands Engine Supply Research Report: Low Carbon Supply Chains, March 2021

Figure 8. Schematic of the Midlands Engine Green Innovation ecosystem.

8 PROPOSED ACTIONS AND RECOMMENDATIONS

The recommendations present here reflect: the urgent need to support the region's industry; the enormous opportunities in cleantech, low carbon transport and sustainability sectors over the coming decade; and the fact coordinated action will place the Midlands Engine in a more competitive position to attract investment. Convening partners and embedding these actions at a Midlands Engine level is vital.

Recommendations for accelerating green innovation:

1. Coordinate green innovation activities across the region and create a platform to showcase examples of green innovation.

Current status: limited cross-region engagement on specific areas of innovation across the region (noting West Midlands Innovation Accelerator programme focused on the West Midlands).

Proposal: Provide a knowledge exchange forum to support green innovation focused organisations and connect them with researchers, funders and other service providers in the region.

- Series of events/activities run by the network
- Support groups identifying and applying for innovation funding
- Showcase green innovation activities taking place in the region
- Annual Awards event to promote activity

2. Establish, and seek funding for a programme to support energy intensive business to decarbonise and drive down energy costs and increase efficiency.

Current status: There are pockets of support and activity, for example in the Black Country, but the level of coordinated activity is insufficient to support the sector.

Proposal: Work with regional organisations to establish a network to help businesses:

- Transition to hydrogen or electrical induction processes, sourcing affordable energy from local generation
- Develop energy-from-waste or biomass plants in collaboration with businesses to then collectively procure power through power purchase agreements.
- Create industrial clusters around processes like waste heat re-use.
- Provide advice and support on decarbonisation through generating renewable energy and accessing low carbon, cheaper energy options in the market.
- Circulate learnings from smart energy demonstrator projects like SEND, highlighting energy savings to be made through smart energy interventions.

3. Develop an advisory and support programme to enable businesses to pivot and grow in the cleantech sector

Current status: There are a number of programmes in place across the region (with ERDF supported projects ending in 2023), but these tend to be focused on specific areas or technologies. Future Shared Prosperity Fund funding likely to be limited in scale.

Proposal:

- Bring together organisations that can provide support (such as reskilling, manufacturing advice, test facilities, business finance, supply chains) into a regional green innovation offering able to provide support to organisations either establishing or growing in the sector.
- Seek funding for a focused programme around green innovation which can provide tailored acceleration and growth support to high potential businesses active in the region.
- Establish green innovation co-creation spaces to enable collaboration and acceleration of green innovation in the region.

4. Support the development of funded region-wide thematic innovation programmes

Current status: Presently the HyDEX programme is supporting the development of a hydrogen ecosystem across the region.

Proposal:

- Establish additional programmes across the Midlands Engine in areas such as smart energy, zero carbon transport, nuclear energy, recycling and the circular economy, energy storage and heat and zero carbon buildings.
- Develop supply chain maps for new regional industries (such as heat pumps or hydrogen trucks, and promote the Midlands as supporting these industries.
- Utilise the Net Zero Research & Innovation Framework to review other potential areas.

Images ©Viritech

5. Advocate for new RD&I facilities for the region.

Current status: There are a range of projects developed and facilities established, but sometimes these compete and are not strategically aligned.

Proposal: Identify, develop and support development of key innovation facilities and activities for the Midlands. For example:

- The National Centre for Decarbonisation of Heat (project under consideration via the Levelling Up fund application).
- National Energy Storage Demonstration Facility.
- ZERO proposal focused on net zero energy at the Ratcliffe-Upon-Soar power station site and the East Midlands Freeport.
- Nuclear R&D facilities.
- Net zero development district such as the Broadmarsh Centre redevelopment.
- Three cities retrofit project (Birmingham, Coventry and Wolverhampton) to unlock green economic growth, address decarbonisation and boost investment.
- Creation of smart and net zero cities/regions for example Nottingham/Birmingham
- West Burton STEP Fusion Reactor.

6. Support the development of a Net Zero Skills directory, connecting the regional skills, training and degree programmes into a Midlands Net Zero Academy.

Current status: Many college and university programmes across the region, but low levels of linkage and coordination

Proposal:

- Create a directory, organised thematically and by skills level, which brings all the programmes together in a single place.
- Establish links between programmes and opportunities for progression.
- Establish a Midlands Net Zero Academy identity.
- Work with industry to profile programmes and develop new training

9 APPENDIX: MIDLANDS GREEN INNOVATION NETWORK

Following the recommendations laid out in this report, Midlands Engine, Energy Research Accelerator and Federation of Small Businesses are partnering together to pilot the Midlands Green Innovation Network (MGIN) – a knowledge exchange network delivered through a series of online webinars and in-person events rotating around the Midlands. The discussion forum will bring together businesses – focusing on SMEs and start-ups – with university R&D support and other innovation-support organisations.

Date	Topic and details	Venue
15 December 2022	**MGIN Launch: Innovate to Thrive! -** hear about real-world examples of how businesses can get funding for innovation.	University of Nottingham
12 January 2023	**Thinking Outside the Box** – how to look at your problems in new ways to find innovative solutions.	Online
9 February 2023	**Skills for the Green Economy** – what skills are needed by businesses for the new green economy? Opportunity for business to feedback into the Local Skills Improvement Plan.	Derby University
2 March 2023	**Protecting Your Ideas** – learn from the UK's Intellectual Property Office how you can protect your ideas and technologies.	University of Birmingham
20 April 2023	**Sustainable Product Development and Design** – how to design sustainable products.	De Montfort University
May 2023	Future events to be developed and modified in line with business feedback from earlier events.	TBC
June 2023		
July 2023		
September 2023		

Through this network, we aim to ensure our region is capitalising on the strengths and capabilities within the region, fostering an innovation ecosystem where new green technologies, services and products can emerge.

MIDLANDS ENGINE

www.midlandsengine.org
green.growth@midlandsengine.org
@Midsengine
midlands-engine

This document is printed on recycled paper.