

# ENERGY SECURITY, NET ZERO AND ECONOMIC GROWTH – WE REALLY COULD HAVE IT ALL

## How research and innovation funded by UKRI is creating the opportunity to build a sustainable, resilient, secure, and prosperous energy system in the UK



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### WHAT DO WE MEAN BY ENERGY SECURITY?

Quite simply, it is a term used to describe our reliance on energy and our basic need to have uninterrupted, reliable, and affordable access to energy to sustain people's lives and daily activities. Access to energy is critical to economic growth, political stability and the overall development and security of our industries (for example, manufacturing and agriculture) making security of supply critical<sup>1</sup>.

### WHAT ENERGY SECURITY CHALLENGES ARE WE CURRENTLY EXPERIENCING IN THE UK?

The high energy prices impacting households and businesses throughout the UK today have really brought energy security to the fore. They have exposed risks associated with our dependencies on global supply chains for oil and gas and the effect of price rises for those commodities, which can be driven by many factors including increased demand and fuel shortages. However, we are exposed to many other risks including equipment failures, the effects of climate change such as adverse weather events, risks associated with our transition to clean energy sources such as the need for greater system flexibility, a lack of investment or system operability challenges

and now due to the increased digitalisation of our energy system, cyber security risks<sup>2</sup>. Given energy is so critical to the function of our society it is essential that we act to mitigate these risks.

### HOW ARE WE WORKING TO TACKLE THESE CHALLENGES THROUGH RESEARCH AND INNOVATION?

As the UK's largest public funder of research and innovation, UKRI is investing in research and innovation to support a sustainable, resilient, secure, and prosperous energy system. These investments are working to help boost our energy security, reach net zero, secure economic growth through the creation of new businesses, jobs and opportunities and bring wider benefits to bear such as improved air quality.

### Reducing our energy demand will reduce our reliance on current energy supply chains in the near and medium-term.

Firstly, a major priority is delivering solutions to reduce energy demand including energy efficiency improvements through both technological and social solutions. Less demand means producing less energy which in turn would mean less greenhouse gases being produced and less reliance on current global energy supply

chains. Win, win for energy security and net zero and if we develop the solutions here in the UK, we can create value from the commercialisation and exploitation of those solutions.

The UKRI funded Centre for Research into Energy Demand Solution (CREDS) brings together researchers, businesses, and policy makers. They work together to understand the role of energy demand change in accelerating the transition to a zero-carbon energy system, including the technical, social and governance challenges of demand reduction, flexible demand, and use of decarbonised energy<sup>3</sup>. CREDS research published recently in *Nature Energy*, provides a world-first framework to understand how much energy demand reduction developed countries can achieve at a national level and identified that the UK can halve its energy demand by 2050<sup>4</sup>.

Energy is required to transform raw materials into products. Therefore, increases in resource efficiency are a critical component of energy demand reduction. The UKRI funded National Interdisciplinary Circular Economy Research (NICER) Programme is working to accelerate solutions. These solutions will enable circularity of specific resource and waste streams to improve resource efficiency focussing on

construction materials, textiles, chemicals, and both structural metals and technology metals<sup>5</sup>. For example, the development of an electric pulse treatment technique by the NICER Circular Metals Centre has resulted in the ability to extend the service life of a steel component by 75%.

The UKRI funded Centre for Sustainable Road Freight has developed both software-based solutions and aerodynamic design modifications that are now in use. These solutions have reduced the energy demand (through fuel efficiency improvements) of freight vehicles, which in turn is leading to cost savings for hauliers<sup>6</sup>.

### **Diversification of the energy mix and UK production capabilities to boost our resilience**

Secondly, UKRI is investing in the development of low and zero carbon solutions to meet our energy needs through extensive electrification and alternative sustainable fuels. This is important for energy security as it enables us to draw on a more diverse suite of energy generation technologies and fuels as we transition to net zero, which provides a huge opportunity to enhance our energy security and resilience in the UK. It means if a risk materialises that impacts one mode of energy generation, we will still have other production methods in service to meet our needs. Such energy generation technologies and fuels include advanced nuclear, offshore (wind, marine and tidal), solar, geothermal, bioenergy and hydrogen. However, all come with their advantages and limitations and therefore coupled to this we need energy storage and flexibility solutions to enable us to match supply with demand and ensure these systems are physically and digitally secure.

For example, UKRI funding led to the discovery of the most efficient solar cells in the world,

which utilise perovskite technology and generate a third more electricity than traditional based solar cells. This formed the basis of Oxford PV who are now commercialising and manufacturing the technology for global markets.

UKRI's long-term investments in offshore wind R&D have ensured the UK has attracted and anchored some of the world's leading offshore wind business R&D capabilities in the UK. This in turn enabled the UK to secure one of the largest offshore wind capacities in the world, which is already contributing to the UK energy mix. For example, EPSRC Prosperity Partnership funding has brought Ørsted, the world's largest offshore wind developer, into collaboration with leading UK academics.

The UKRI funded SPECIFIC Innovation and Knowledge Centre delivered the UK's first affordable energy positive house, which delivers savings of up to £1,000 a year on energy bills and over the course of a year exports 1.3 times more electricity to the grid than it consumes, thus resulting in overall net negative carbon emissions, equating to around -179 kg per year<sup>7</sup>.

The UKRI funded EnergyRev Consortium are leading the way in identifying the standards that are needed to ensure cyber security in smart local energy systems<sup>8</sup>.

### **Securing UK supply chains for clean energy technologies to reduce global dependencies in the medium to long-term**

Thirdly, UKRI is investing in the research and innovation that is needed to transform manufacturing to increase sustainability, create and recover maximum value from products across their whole life cycle and secure UK-based industrial supply chains for clean energy technologies. If we also

make these technologies in the UK, as well as using them, they can be supplied for domestic needs and sold to the rest of the world. This in turn secures economic benefit in the UK while also enhancing our energy security.

For example, UKRI funded research has led to technology breakthroughs that have created companies such as Ceres Power that is manufacturing fuel cell technologies and valued at over £1 billion with over 300 employees and ITM Power, which is now responsible for the largest electrolyser factory in the world in Sheffield. ITM Power manufactures integrated hydrogen energy solutions to enhance the utilisation of renewable energy that would otherwise be wasted.

UKRI manufacturing research investments, led by EPSRC, have resulted in reduced carbon emissions of £5.9 billion at the UK level associated with the successful development of technologies such as fuel savings for more efficient aircraft engines, reduced lighting and display emissions, large-scale photovoltaic solar and more efficient data storage<sup>9</sup>.

### **Ensuring the UK is the leader for the next generation of clean energy technologies to strengthen our long-term energy security**

Finally, UKRI is investing in the blue skies research to pioneer the next generation of clean energy technologies. These include the next generation of battery technologies through the Faraday Institution with increased energy density, reduced cost and enhanced sustainability<sup>10</sup>. As well as transformative technologies such as fusion energy. Fusion energy is one of the most promising options for cleaner energy that would bring benefits which include no carbon emissions, abundant fuels, a step change in energy

efficiency (one kilogram of fusion fuel could provide the same amount of energy as 10 million kilograms of fossil fuels) and a safe and reliable power source and could further enhance our energy security if realised<sup>11</sup>.

## **WE REALLY COULD HAVE IT ALL**

To secure energy security, net zero and economic growth in the UK we need to use less energy; diversify our energy mix and UK production capabilities; manufacture clean energy products, systems, and services in the UK; and continue to push the boundaries to improve our energy capabilities through next generation technologies and solutions. We have the research and innovation capabilities to do this, the time is now here to make sure we exploit it.

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