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Part of the **UK-India** Net Zero Innovation Virtual Centre

A whole systems approach & international cooperation

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Department for Science, Innovation, & Technology

UK Research and Innovation

CATAPULT Energy Systems

Catapult network

Supporting business in transforming great ideas into valuable products and services

Technical capabilities, equipment, and other resources

Open up opportunities for innovators, in the UK and globally

Solve key problems and develop new products and services

Bridge the gap between stakeholders in the sector

- Cell and Gene Therapy
- Connected Places
- Compound Semiconductor Applications
- Digital
- Energy Systems
- High Value Manufacturing
- Medicines Discovery
- Offshore Renewable Energy
- Satellite Applications

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About Energy Systems Catapult

Mission: Unleashing innovation and open new markets to capture the clean growth opportunity

Why do we exist?

To accelerate Net Zero innovation and deliver the future energy system

How do we work?

We do the hard stuff by taking a whole systems approach to Net Zero

What do we do?

Turboboost innovation across homes, sites, places, whole systems & networks.
Design a future energy system to drive clean growth and benefit people.

What we do

Supporting innovators to commercialise

- CONSUMER INSIGHT AND PROPOSITION DESIGN
- BUSINESS MODEL INNOVATION
- HARNESSING DIGITAL AND DATA
- TEST AND DEMONSTRATION
- DELIVERING LARGE SCALE INNOVATION TRIALS

Helping to design the future energy system to unlock innovation

- WHOLE SYSTEM MODELLING
- CLEAN TECH ENGINEERING
- SYSTEM ENGINEERING
- INTEGRATING THE TRANSPORT AND ENERGY SYSTEMS
- MARKETS, POLICY AND REGULATION
- DECARBONISING THE PUBLIC SECTOR ESTATE
- DECARBONISING LOCAL PLACES
- DECARBONISING CAMPUSES, BUSINESS PARKS AND INDUSTRIAL SITES

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Our expertise

Whole systems thinking

JOINING UP THE SYSTEM FROM SOURCES OF ENERGY TO THE CONSUMER

Generation + Transmission + Distribution + Buildings + Consumer

BREAKING DOWN SILOS BETWEEN DIFFERENT PARTS OF THE ENERGY SYSTEM

Electricity + Heat + Transport

JOINING UP PHYSICAL REQUIREMENTS OF THE SYSTEM, WITH POLICY, MARKET AND DIGITAL ARRANGEMENTS

Physical System + Digital System + Market System + Policy

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The need for a whole systems approach

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Innovating to Net Zero

Consumer insights into public understanding and attitudes

Markets, policy and regulation implications

Digitalisation of the energy sector

Infrastructure and engineering deep dives including:

Advanced nuclear

Storage and flexibility options

https://es.catapult.org.uk/reports/innovating-to-net-zero/

Hydrogen in the future Net Zero energy system

"Zero carbon energy vectors require unprecedented scale-up to dominate final energy use!"

Hydrogen is repeatedly selected in scenarios for a future "least cost optimised zero carbon energy system".

"**Electricity generation itself may have to double, or even treble** if most hydrogen is to be produced by electrolysis."

"**A new low carbon hydrogen economy will need to be created, delivering up to 300TWh** per annum, roughly equivalent to electricity generation today."

INNOVATING TO NET ZERO

300

TWh per year

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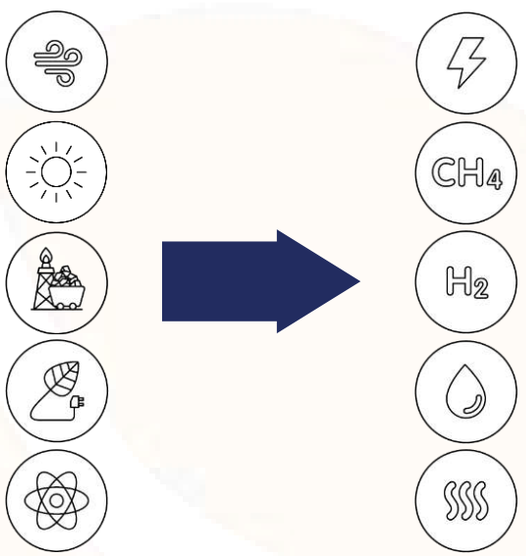
What do we mean by the energy system?

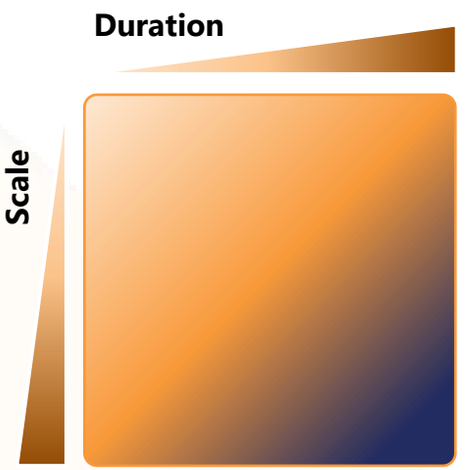
Production

Producing useful energy from available resources



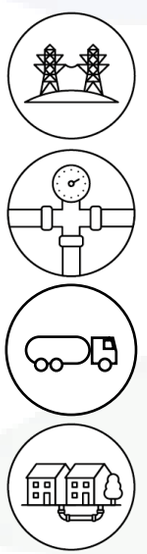
Storage

*Holding useful energy until **when** it is needed*



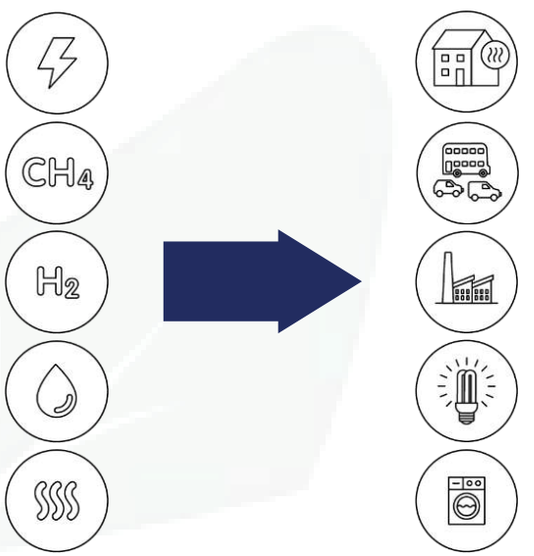
Distribution

*Moving useful energy to **where** it is needed*



End-use

Turning useful energy into useful outputs



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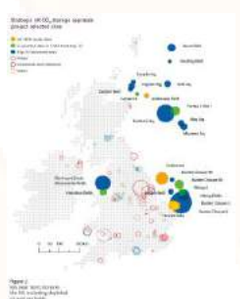
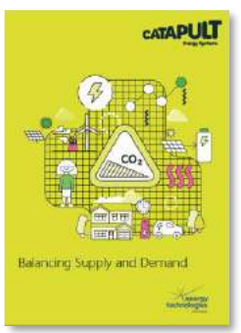
Establishing the market potential for hydrogen

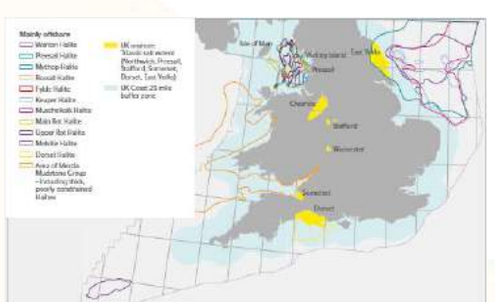
Examining hydrogen's potential role throughout the energy system

Production



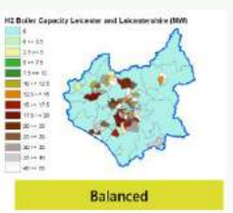
Storage





Distribution

End-use



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Hydrogen modelling capability

Production | Storage | Distribution | End-Use

ESME
Energy System Modelling Environment

National energy system modelling

Creating whole system evidence

Informing policy and research

Testing system value of innovations

Storage and Flexibility Model

Balancing supply and demand

Considers energy vectors: across hydrogen, electricity gas and heat

Accounts for operation and risk factors

Infrastructure Transitions Analysis Model

National, regional to local infrastructure requirements

Considers requirements across production options

Considers different energy end-uses

Road freight model

Low carbon road freight options

Fleet implications and infrastructure requirements

Operator investment and vehicle duty cycle factors

Consumers, Vehicles and Energy Integration Model

Integrated, holistic means of assessing the impacts on and from vehicle uptake and use, consumer preferences, infrastructure, policy measures and commercial models across the system

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Whole systems thinking: key benefits

- Identify the least-cost pathways to Net Zero
- Define innovation priorities → the least-regret options → money saved
- Intra & inter-sectorial synergies → economies of scale
- Predictability and institutional security, driving investment attraction
- Reduces cost of capital
- Potential opportunities and premiums for low-carbon services and goods

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Creating an enabling environment for innovation

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Hydrogen supply, use & business are still highly uncertain

- **Demand**: Most promising are hard-to-reach sectors (i.e., HGVs; shipping; industry; and power generation (potentially)).
- **Supply**: Unclear whether Steam Methane Reformation (SMR) + Carbon Capture & Storage (CCS); or electrolysis most likely success.
- **Heating:** Significant uncertainty about heating & therefore future of gas grid.
- **Transportation:** Trajectory for decarbonising passenger cars and other light duty vehicles is electric – heavy-duty vehicles is less clear cut.
- **Storage:** Gas can have a valuable role – this could be hydrogen, natural gas, SNG and other molecules as line-pack, long and medium range storage.
- **Innovation:** Very significant innovation challenges (E.g., production (green and blue); pipes; consumer acceptance; storage; and transition pathway).

Whilst the apparent need for hydrogen in the energy system is substantial, understanding the role for hydrogen is a whole system question.

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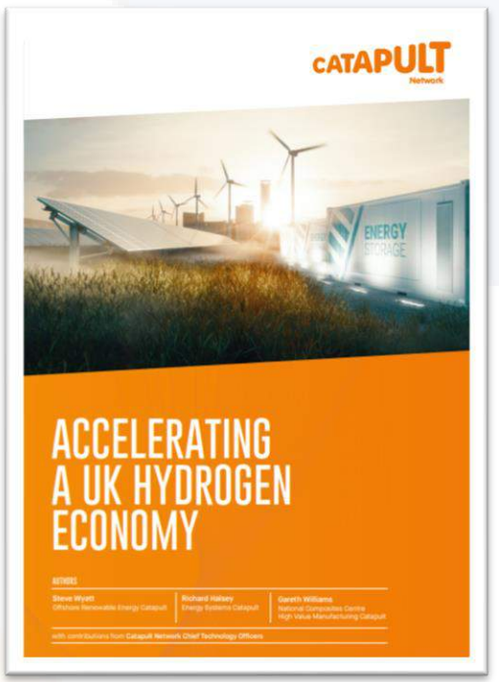
The Hydrogen Innovation Initiative

Leveraging specific techno-economic competencies

Multi-Vector Perspectives

- Electricity
- Heat
- Industry
- Infrastructure
- Transport
- Consumer



The Hydrogen Innovation Initiative

Technical & Socio- Economic Competencies

- Modelling
- Digital & data
- Markets, Policy & Regulation
- Systems Integration
- Consumer Insight
- Infrastructure & Engineering

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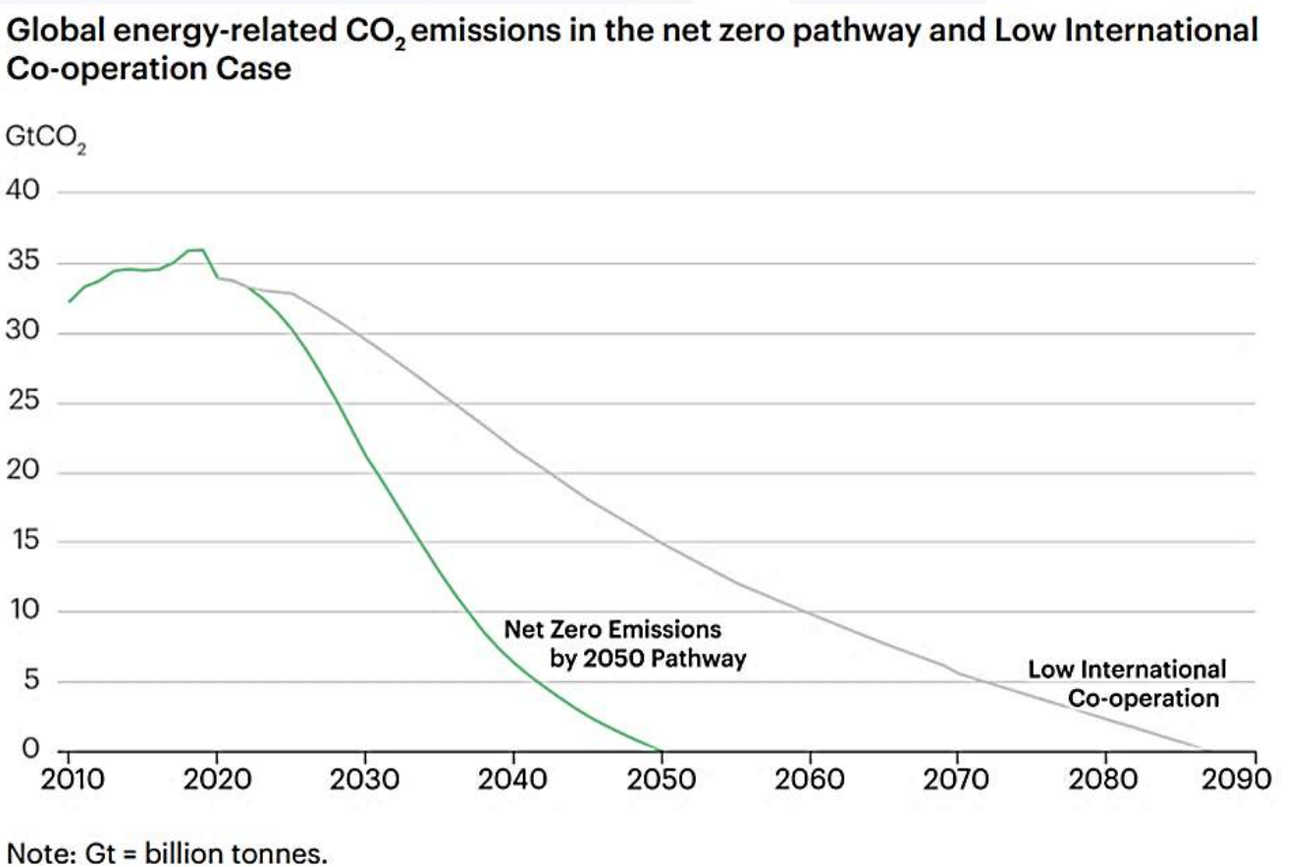
International collaboration is key for reducing emissions

- The Net Zero pathway **relies on unprecedented international collaboration**, especially on **innovation** and **investment**

- This is not simply a matter of governments and companies seeking to bring their emissions to Net Zero – it means tackling global challenges through **co-ordinated actions**



From IEA, 2022: https://www.iea.org/data-and-statistics/charts/global-energy-related-co2-emissions-in-the-net-zero-pathway-and-low-international-cooperation-case-2010-2090

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THE UK-INDIA NET ZERO INNOVATION VIRTUAL CENTRE

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THE UK-INDIA NET ZERO INNOVATION VIRTUAL CENTRE

The UK-India Net Zero Innovation Virtual Centre is a unique coalition of UK and Indian innovation policymakers, R&D companies, start-ups, hubs and places, investors and research groups.

The Centre will initially focus on **three key areas:**

DECARBONISING MANUFACTURING PROCESSES

INNOVATING FOR TRANSPORT AND ENERGY SYSTEMS

HYDROGEN SYSTEMS

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Innovating for Transport and Energy Systems

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Obstacles to action

LACK OF RESOURCES

- Tight budgets
- Lack of expertise

LACK OF REAL-WORLD IMPACT

- Challenging to involve citizens
- Without businesses there won't be scale up
- Difficult to progress beyond hypothetical solutions

LACK OF WHOLE SYSTEMS APPROACH

- Complex challenges with lots of variables
- Unintended impacts
- Innovation regrets
- Vested interests
- "Bottom-up approach"

INNOVATION IS RISKY

- Testing new things risks failure
- Procurement challenges
- Risky investments
- Gap between challenge owners and solution providers

Our mission

ITES is a collaboration between **leading research organisations from India and the UK**. ITES will address **transport and energy decarbonisation** challenges by:

- **Linking research and innovators to real market and industry needs**, to ensure applied solutions
- **Taking a whole systems approach to sectoral challenges**, considering all aspects from consumer acceptance, to business models, policy, to supporting infrastructure
- **Leveraging expertise from both countries** to accelerate the development of solutions
- **Supporting scale-up for innovators** by creating pilot and test opportunities **in a risk-free environment**, and giving them access to technical support and expertise
- Providing evidence for **informed decision-making** around policy and regulation
- Acting as a **credible broker between stakeholders**, remaining **independent** and free from vested interests

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Programme overview

Challenge identification	Innovation sprint	Outcomes	Scale up
Market Analysis: Engagement with partners to identify decarbonisation challenge needs	**Research sprints** to develop analytical capability and tools	**Tools** to generate evidence on innovation barriers and needs	**Evidence** to inform the sector and policy via impact reports and industry events
Supply Chain Analysis: Assessment of available /pipeline solutions	**R&D sprints** to develop applied solutions	**Innovative solutions** developed in line with market needs	**Solutions** showcased to ITES partners and wider sector via events and workshops
An innovation roadmap developed for key challenges	**Demonstration / pilot projects** for close to market solutions	**New solutions** trialled in real-life market settings	**Products** ready to enter the market

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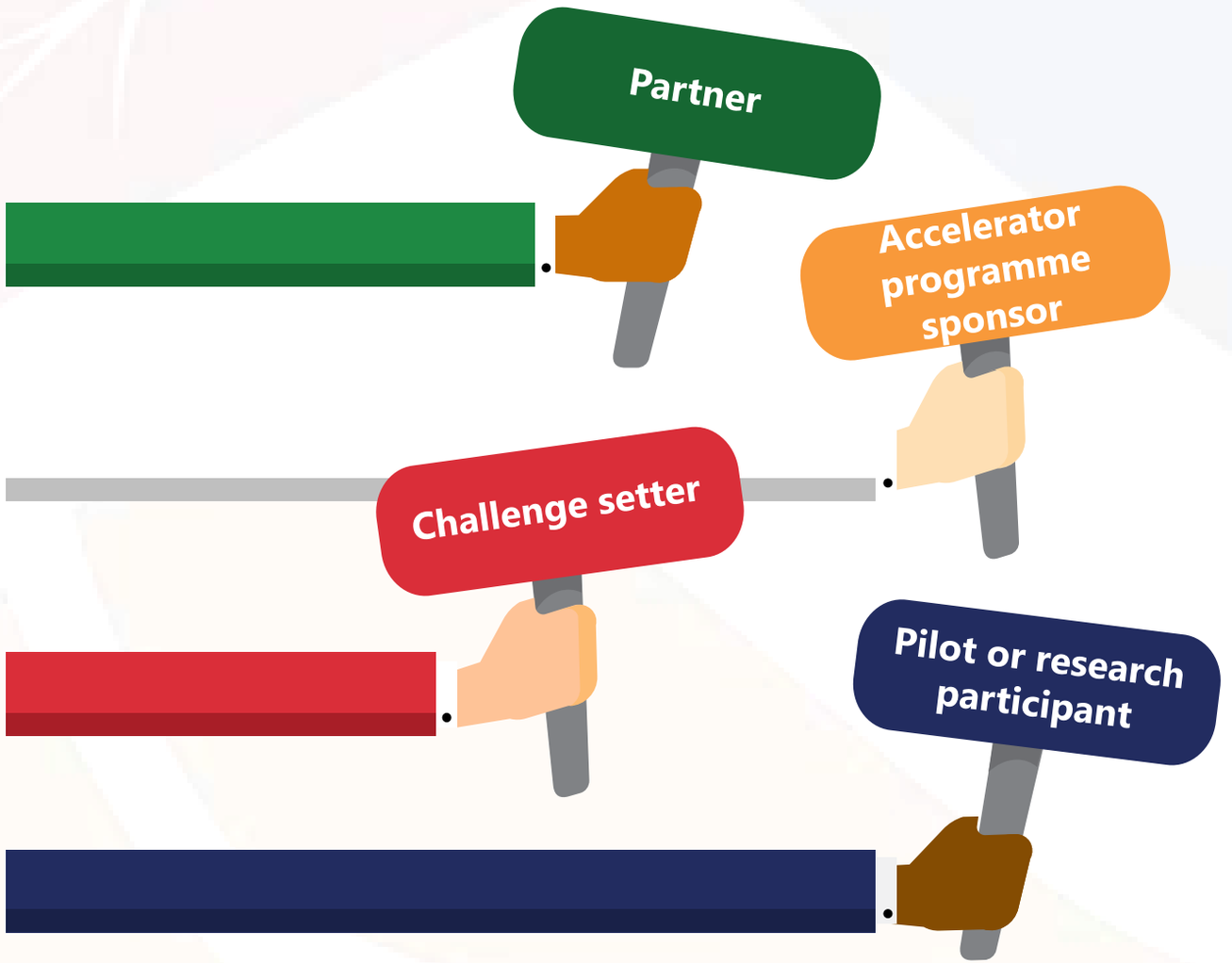
Ways to engage



Partner

Sponsor the centre and help to steer its work and maximise its impact

Accelerator programme sponsor

Sponsor an SME accelerator programme

Challenge setter

Sponsor a challenge for your organization and we will develop innovative pilots to explore solutions

Pilot or research participant

Participate in a pilot with your question or facilities or in a research project

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Thank you

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