12 May 2025

Non-Electric Applications of SMRs: Catalyzing Clean Hydrogen Production and Beyond

NNWI
New Nuclear Watch Institute

Panel 2: Policy Frameworks for Integrating Nuclear Energy in Hydrogen Production and Other Applications

Moderator: Elina Teplinsky, Partner and Energy Industry Leader, Pillsbury Winthrop Shaw Pittman LLP; Leader, Nuclear Hydrogen Initiative

- **Alasdair Harper**, Deputy Director for Advanced Nuclear Policy and Delivery, Department for Energy Security and Net Zero (DESNZ)
- **Dr. Emma Guthrie**, Chief Executive Officer, Hydrogen Energy Association (HEA)
- **Allan Simpson**, Chief Technologist, Equilibrion

Department for Energy Security & Net Zero

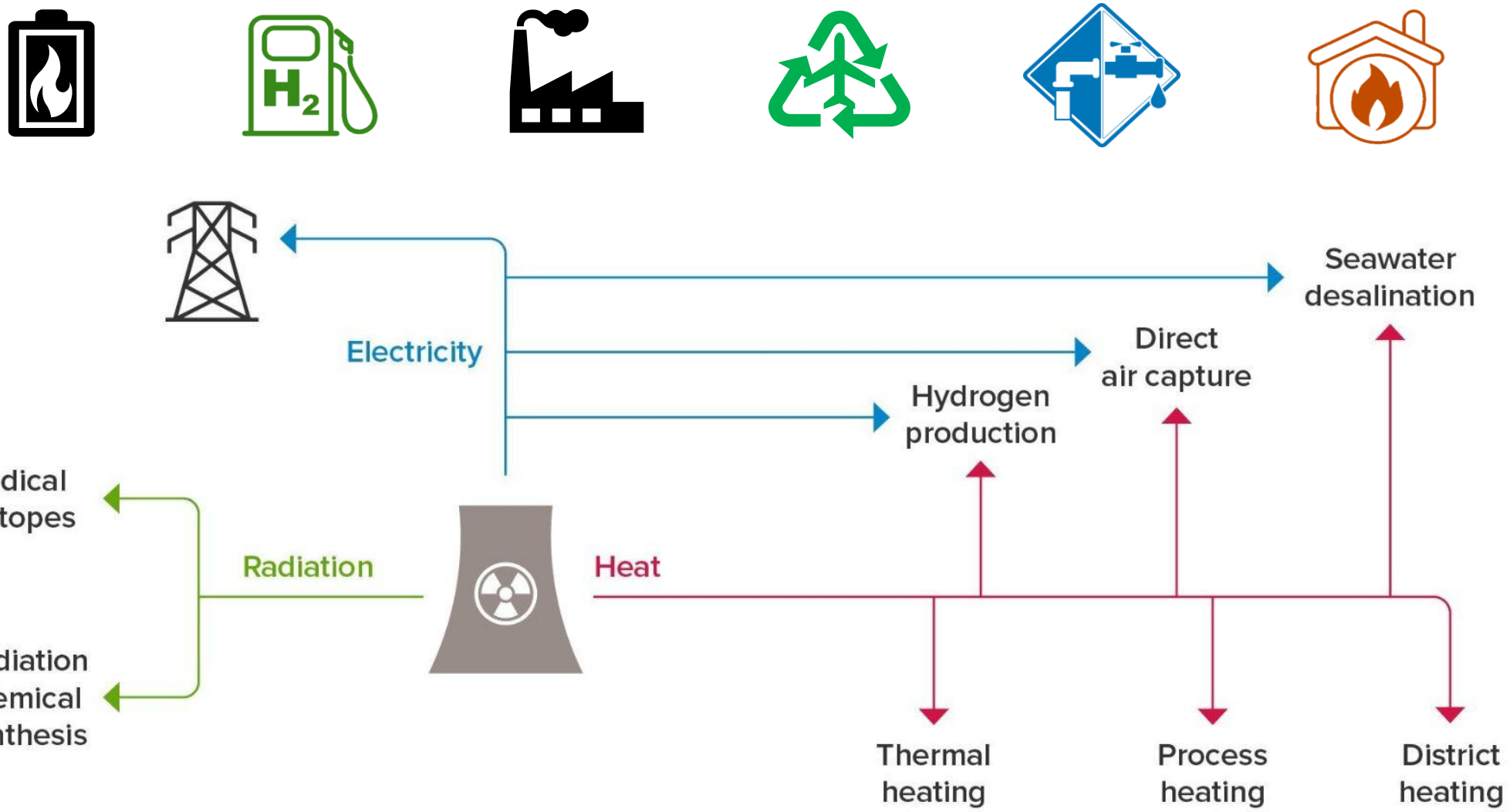
May 2025

Advanced Nuclear Beyond Electricity

Policy Frameworks for Integrating Nuclear Energy in Hydrogen Production and Other Applications

Department for Energy Security & Net Zero

New Uses of Nuclear



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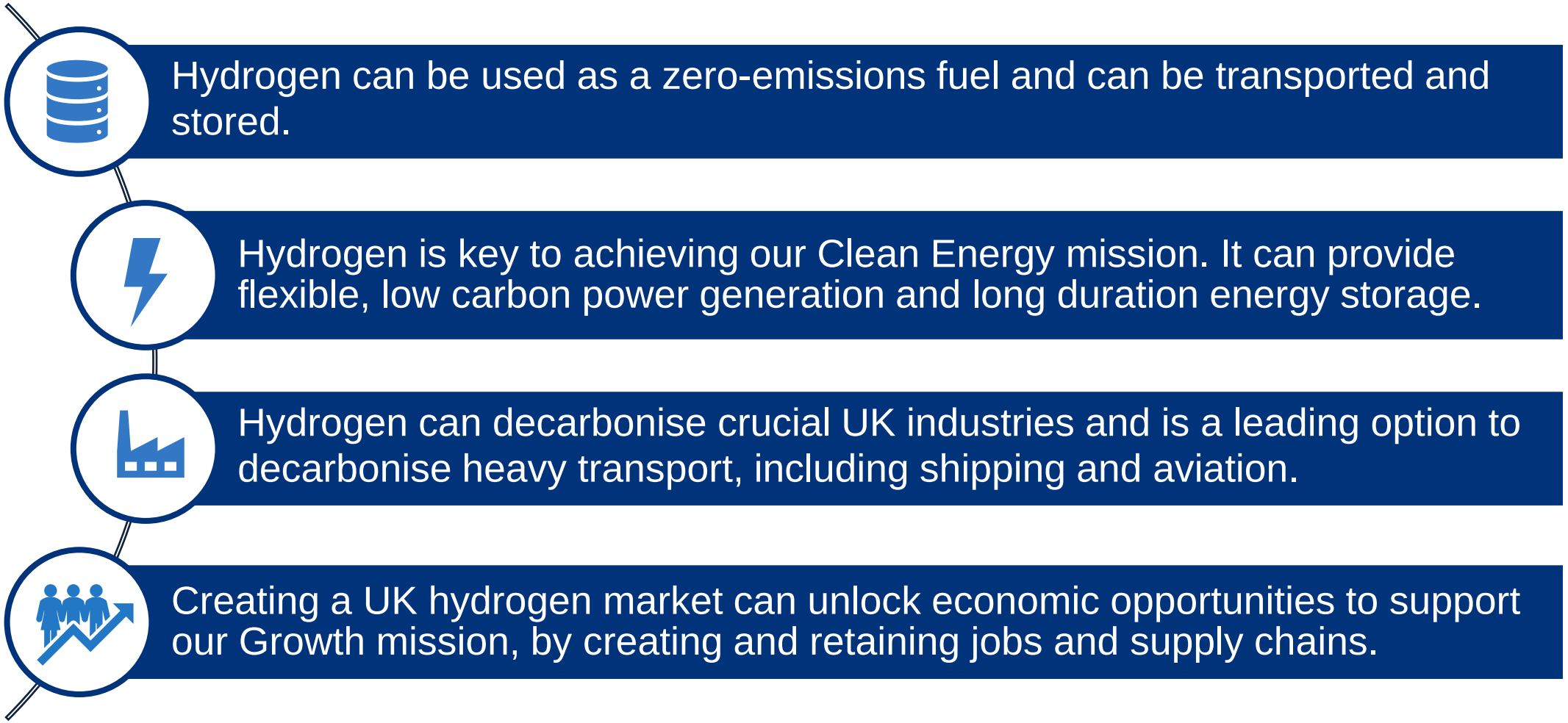
UK Hydrogen Opportunities

Low carbon hydrogen will play an important role in supporting the delivery of our Clean Energy Superpower and Growth missions, as a key enabler of a low carbon energy system.



- Hydrogen can be used as a zero-emissions fuel and can be transported and stored.
- Hydrogen is key to achieving our Clean Energy mission. It can provide flexible, low carbon power generation and long duration energy storage.
- Hydrogen can decarbonise crucial UK industries and is a leading option to decarbonise heavy transport, including shipping and aviation.
- Creating a UK hydrogen market can unlock economic opportunities to support our Growth mission, by creating and retaining jobs and supply chains.

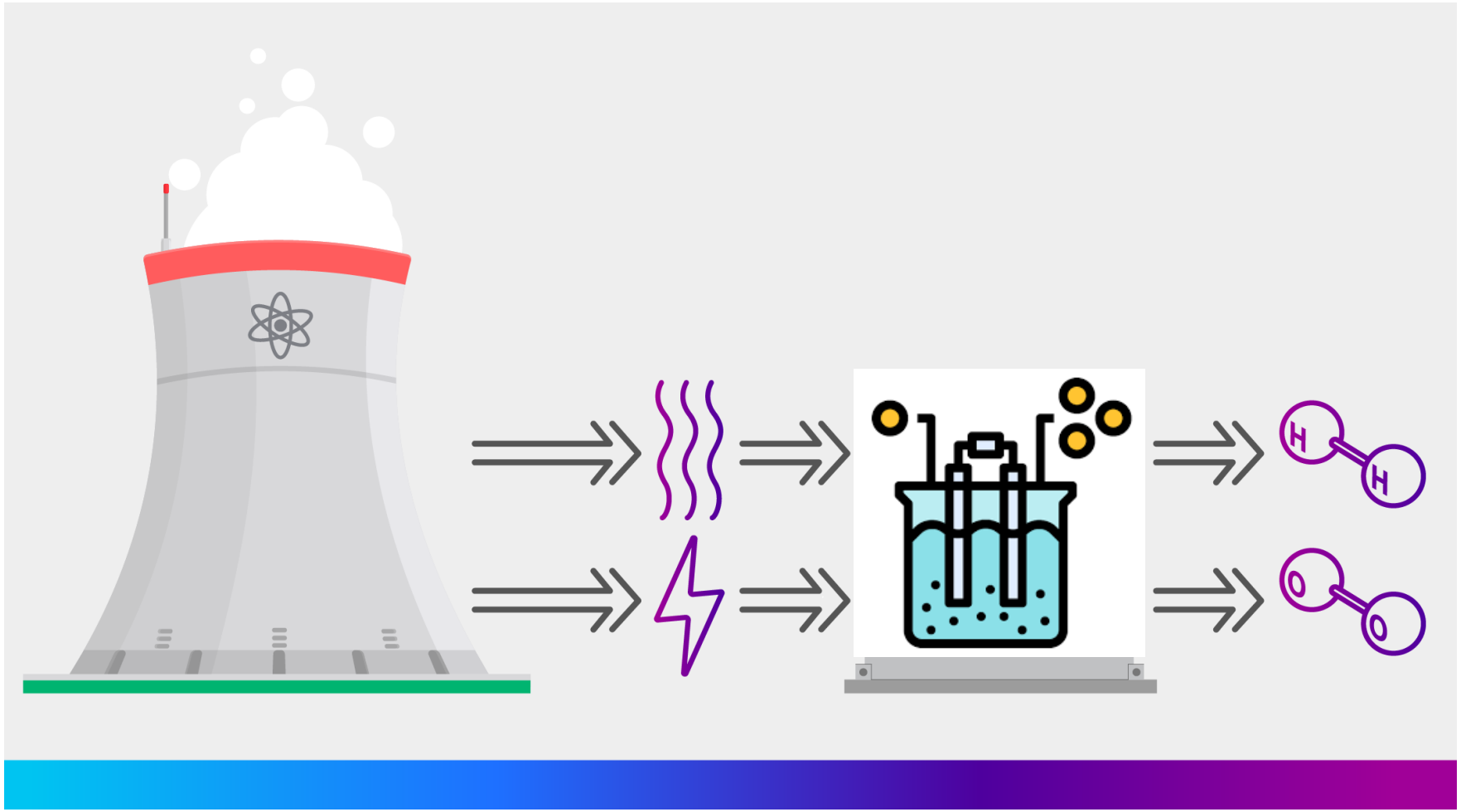
Department for Energy Security & Net Zero

Key Updates: Hydrogen Production

- **Government has confirmed support for HAR1 projects**, comprised of £90m in capital grant support through the Net Zero Hydrogen Fund and around £2.3bn of revenue support through the Hydrogen Production Business Model.
- **£21.7bn funding has been made available** to launch the UK's carbon capture, utilisation and storage (CCUS) industry.
- The Low Carbon Contracts Company is now issuing the first contracts to the **eleven successful Hydrogen Allocation Round 1 (HAR1) projects**. The first 5 HAR1 contracts have been signed with another out for signature.
- HAR2 was launched in Dec 2023 and was oversubscribed. **We have published the HAR2 shortlist**.
- **We are developing our approach for future HARs**.
- We are developing Version 4 of the **Low Carbon Hydrogen Standard**.

Department for Energy Security & Net Zero

Nuclear-Enabled Hydrogen



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Enabling Policy

Planning

- EN-7 consultation published in February
- Designation by the end of 2025
- More flexible, criteria-based siting framework
- Opportunities to co-locate with industrial end users

Regulation

- Nuclear Taskforce launched by the PM
- Exploring whole scope of regulatory system to support delivery of nuclear in the UK
- Call for Evidence
- Recommendations to Ministers by Autumn 2025

Innovation

- Hydrogen R&I through £1bn Net Zero Innovation Portfolio
- HySupply 2 competition
- Industrial Hydrogen Accelerator programme

The Role of Nuclear Energy in Advancing the UK's Hydrogen Strategy

Dr Emma Guthrie, Hydrogen Energy Association

May 2025

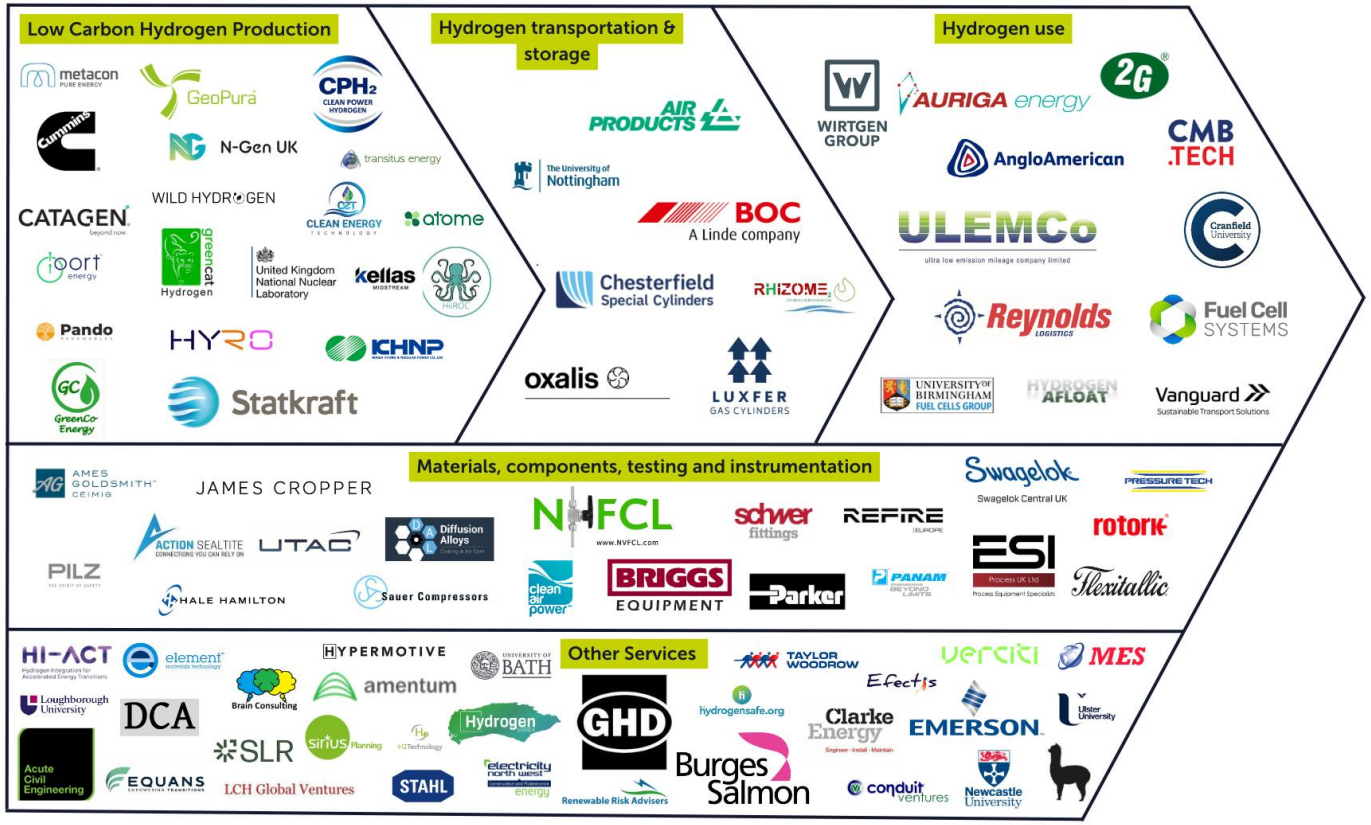
Hydrogen Energy Association

Formerly the UK Hydrogen and Fuel Cell Association

HEA Members

The voice of the UK hydrogen sector, driving its growth

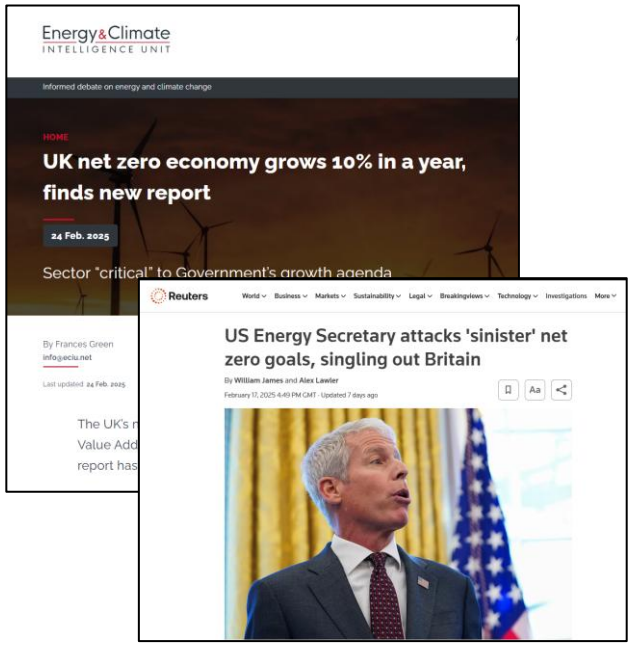
Hydrogen Energy Association

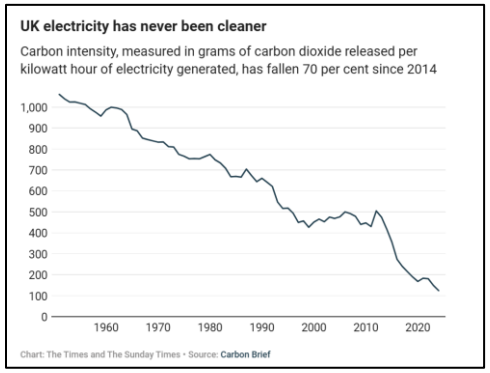


Our >100 members represent over 200,000 employees globally, with combined revenues over £400 billion, and cover the entire value chain from raw material sourcing, to supply chain and components, financing, professional services, B2B and consumer facing solutions.

WE ARE MEMBER FOCUSED

UK context for Low Carbon Energy





- **We live in dynamic times**
- **UK is moving forward with ambitious targets for decarbonisation against the background of a changing global environment**
  - U.S. Energy Secretary referred to a pledge to achieve net zero carbon emissions by 2050 as a "sinister goal", & criticised UK government's attempts to hit clean energy targets.
  - Recent report that stated the UK's net zero economy has grown 10% in a year.
- **UK has a rapidly changing energy mix with ambitious plans to further decarbonise:**
  - In 2024, renewables climbed to a record 45% of UK energy mix.
  - 2025 is likely to be the first year where UK wind power overtakes gas generation.
  - The UK is #3 in Europe and #6 Globally for most attractive renewable energy investment and deployment opportunities (EY June 2024).
  - Ed Miliband, the UK Secretary of State for Energy Security & Net Zero has set the goal of 95 per cent of electricity coming from clean sources by 2030.
  - Low carbon hydrogen is essential to achieve the Government's Clean Energy Superpower and Growth Missions.
- **Despite some shifts in global positioning, we see strong commitment from the UK in driving forward a cleaner, low carbon economy – but it's important to reference solutions that also protect the future energy resilience of the UK as well an enabler for job creation.**

UK context for Hydrogen – Policy framework

- In December 2024 – DESNZ produced a Hydrogen Strategy Update to the Market:
- *'Low carbon hydrogen is essential to achieve the Government's Clean Energy Superpower and Growth Missions.'*
- *'Hydrogen can provide inter-seasonal energy storage, through conversion of electricity into hydrogen and then back into electricity at times of need'*
- *Hydrogen can decarbonise hard-to-abate sectors like chemicals and heavy transport, complementing our wider electrification efforts and accelerating our progress to net zero.*
- **Nuclear is not mentioned in this strategy but reference is made to the importance of low carbon hydrogen production with it being a 'critical part of our future energy system'.**

UK Policy Framework: Encouraging Low Carbon Hydrogen Production – and where will it be needed?

- Government's support is linked to hydrogen production pathways that meet the UK's Low Carbon Hydrogen Standard (LCHS) – so supporting decarbonisation efforts
- The UK Low Carbon Hydrogen Standard sets a threshold for GHG emissions for hydrogen to be considered 'low carbon'.
  - The future Low Carbon Hydrogen Certification Scheme will verify the emissions intensity of hydrogen, using the Low Carbon Hydrogen Standard methodology.
  - The most recent published version of the UK's Low Carbon Hydrogen Standard (LCHS) is **Version 3**, released in December 2023.
  - This version outlines the criteria for hydrogen production methods to be classified as low carbon, including a greenhouse gas (GHG) emissions threshold of 20 grams of CO_2 equivalent per megajoule (gCO_2e/MJ) of hydrogen produced.

Under this definition, hydrogen produced via electrolysis powered by nuclear electricity, can meet this threshold.

UK Policy Framework: Where will be hydrogen be needed?

- The role of low carbon hydrogen – where will it be needed?
  - Hard to electrify industrial applications such as cement and glass manufacture and in the chemicals and refining sectors
  - Sectors with a strong need to decarbonise – e.g. maritime & aviation. These pathways will take longer to develop but will also need long-term thinking in terms of supply models and in regulation change.

UK Policy Framework: The role for Nuclear Enabled Hydrogen and what's next?

- Intermittent renewables are playing an ever-increasing role in our grid capacity
- There is a clear role for NEH in this mix, as a reliable, consistent source of hydrogen for applications with no viable 'off switch'
- In 2024, DESNZ launched a consultation on *Alternative Routes to Market for New Nuclear Projects*
  - In this, the HEA highlighted the shift in the government's nuclear objectives, aiming to deploy more nuclear power over the next three decades than has been built in the past seventy years.
  - **This shift presents a major opportunity for Nuclear-Enabled Hydrogen (NEH)**
  - NEH offers potential for large-scale hydrogen production, to support the decarbonisation of the UK's hard-to-abate sectors.
- HEA noted advanced nuclear as a valuable energy source for hydrogen production.
  - In an energy system, using nuclear as an energy source for hydrogen offers several levels of energy security through strong supplier relations, domestic processing capability, and the long-term storage of fuel.
  - Specific aspects of advanced nuclear technology, in terms of operating cost, scale, location, and technology compatibility would be beneficial for hydrogen production.
- Government has announced a new hydrogen strategy, expected in Autumn 2025, with an update to market expected before then, after the current spending review. **We hope that NEH will find a suitable role within this new strategy.**

Thank you

ukhea.co.uk

Hydrogen Energy Association

Formerly the UK Hydrogen and Fuel Cell Association

equilibrion.

Policy Frameworks for Integrating Nuclear Energy in Hydrogen Production and other Applications

Allan Simpson

May 2025

Equilibrion – Our Business

Equilibrion is a new company set up to fulfil the potential of nuclear energy to decarbonise heat, transport and fuels

We do this in two ways.

Consulting and Advisory

High-value strategic and technical consultancy to support businesses across the full value chain from nuclear to end energy product

Proposition and Project Development

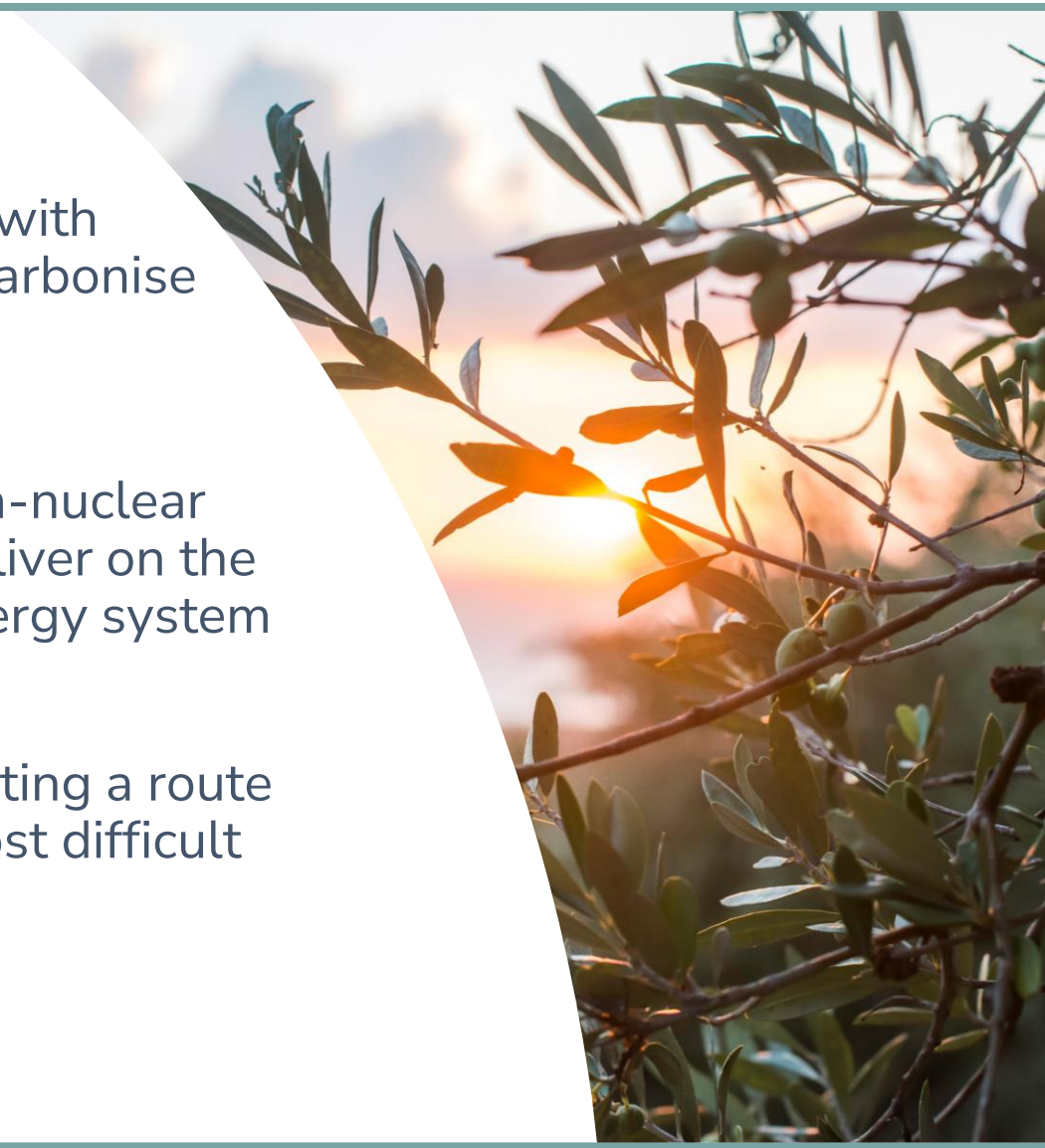
Design and delivery of cross sector propositions for the deployment of end-to-end nuclear energy solutions

Our Vision

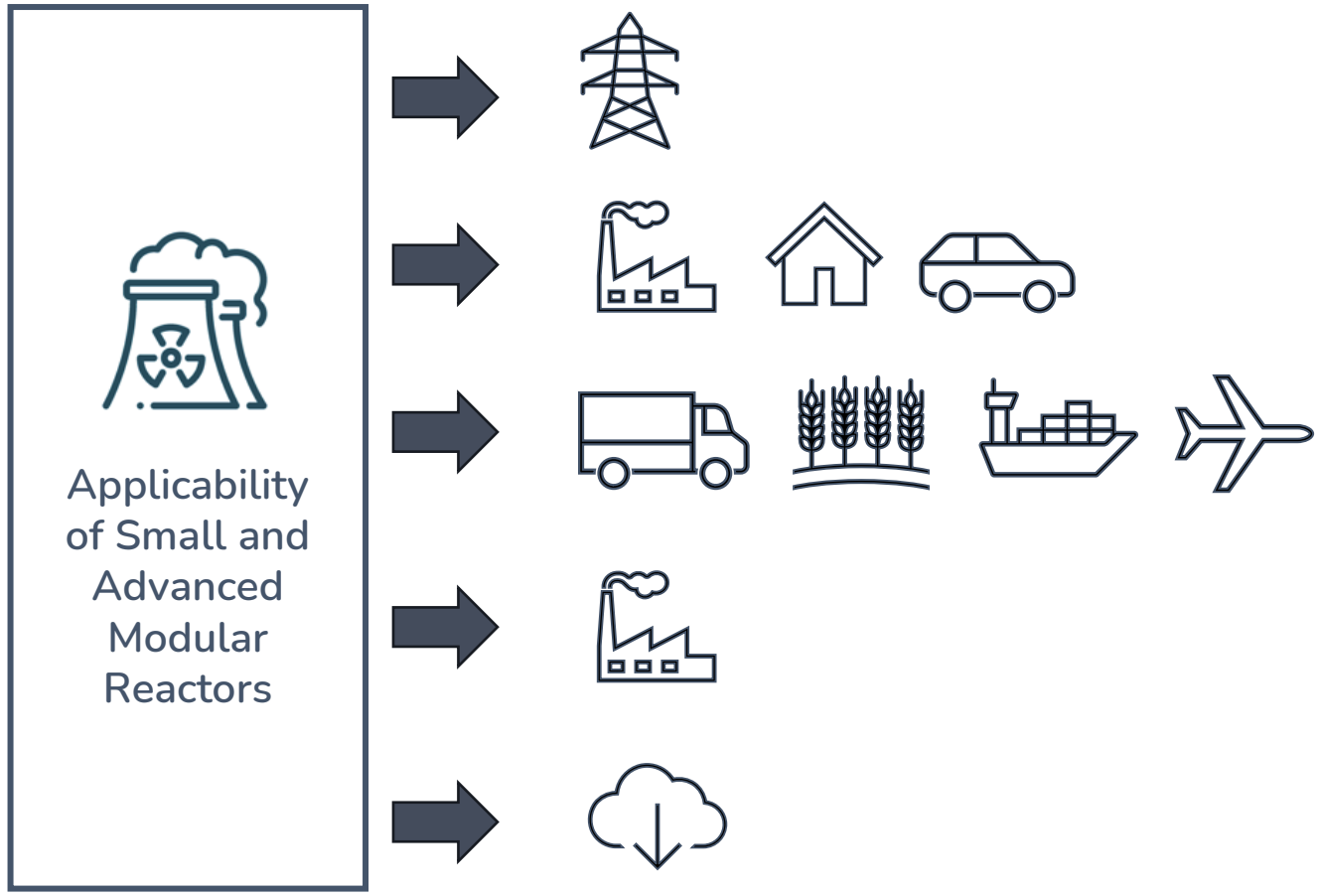
Equilibrion has been set up for one purpose; to work with businesses to fulfil the potential of nuclear energy to decarbonise our heat, transport and industrial sectors

Our knowledge bridges the gap between nuclear and non-nuclear technologies to offer advice and create value chains that deliver on the opportunity for nuclear energy to decarbonise our global energy system

We are a vehicle for change; addressing perception and creating a route by which nuclear heat can tackle decarbonisation of the most difficult parts of the energy system



New Role for Nuclear Energy



Flexible electricity to the grid

Production of low carbon hydrogen at scale to decarbonise industry, homes and transport

Production of synthetic fuels to decarbonise industry, transport and agriculture

Production of direct heat to decarbonise industry

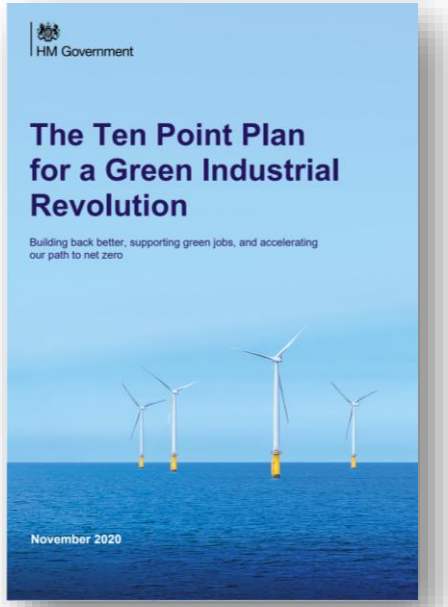
Production of heat and electricity to drive carbon removal processes

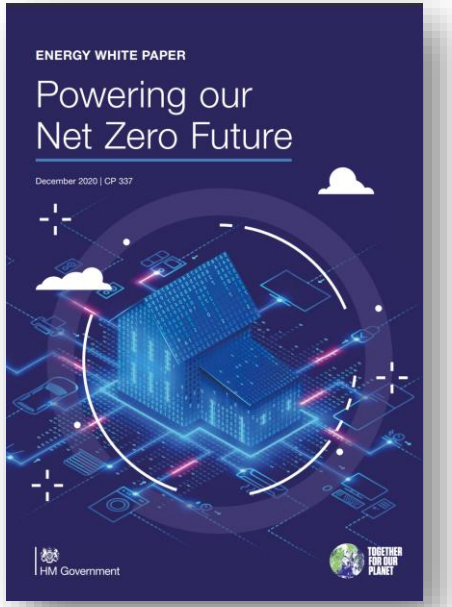
Case Studies – Our Track Record

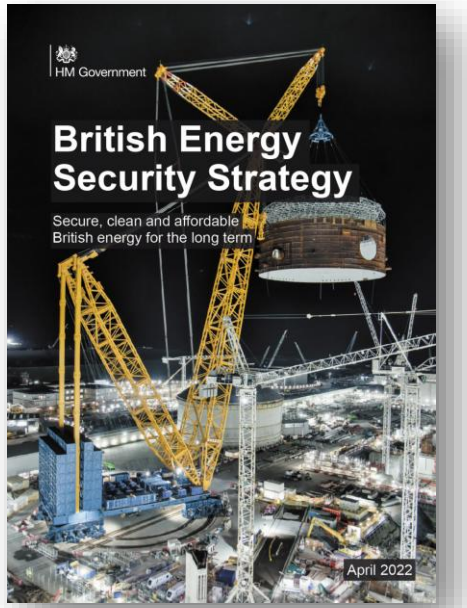
Transport Hub Decarbonisation with Hydrogen and Sustainable Fuels	Bristol Airport	Equilibrion is developing a scheme for producing of hydrogen and sustainable fuels using nuclear energy to decarbonise fuel use at Bristol Airport
Midlands New Nuclear Siting Study	Midlands Nuclear / Midlands Net Zero Hub	Equilibrion has specialist experience developing siting options for new nuclear facilities, with access to unique datasets that enable efficient site identification
Nuclear Reactor Deployment Roadmap	Confidential	Independent assessment of reactor technical and economic suitability to meet the needs of energy-intensive users and sectors, including development of a realistic deployment roadmap
Nuclear-Enabled Hydrogen for Heat Decarbonisation	Regional Gas Networks	Equilibrion has developed a specialist model on the flexible operation of nuclear reactors with hydrogen production, and the associated techno-economic impacts
Investment Appraisal for Advanced Nuclear Technology	International Confidential	Equilibrion provided specialist technical experience to provide an independent assessment of the development status and maturity of a small-scale advanced reactor technology design
Eq.fuels Project Development	Internal	Equilibrion operates as a project developer alongside consulting. The current project being undertaken is Eq.Fuels – a system to produce sustainable fuels from nuclear energy.

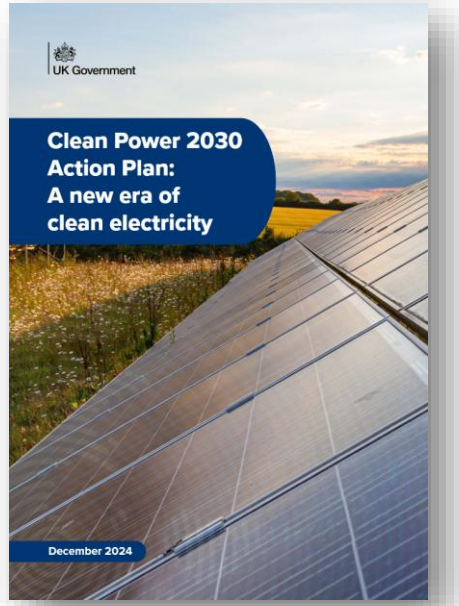
Net Zero in Policy

Government white papers since 2020 have consistently recognised the role of nuclear energy in supporting decarbonisation





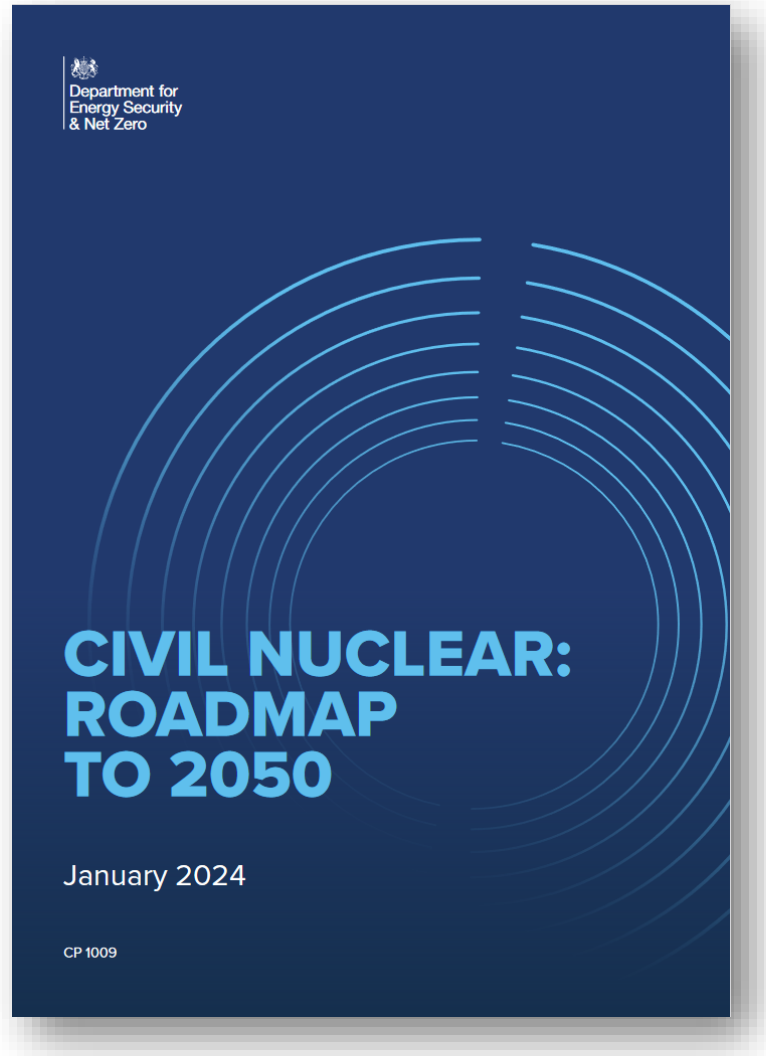




Government Policy & Nuclear

HMG published the roadmap for Civil Nuclear Development earlier this year

- It sets out HMG's approach to delivering the 24 GW target and supporting a range of nuclear technology
- There is an opportunity to bring forward proposals that deliver energy system benefits using nuclear
- Autumn 24 budget allocation of a further £2.7bn for Sizewell C

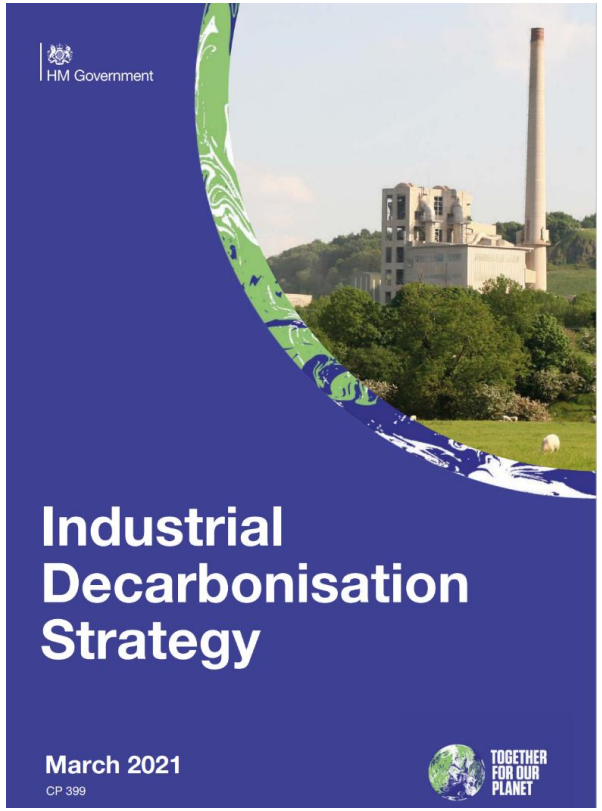


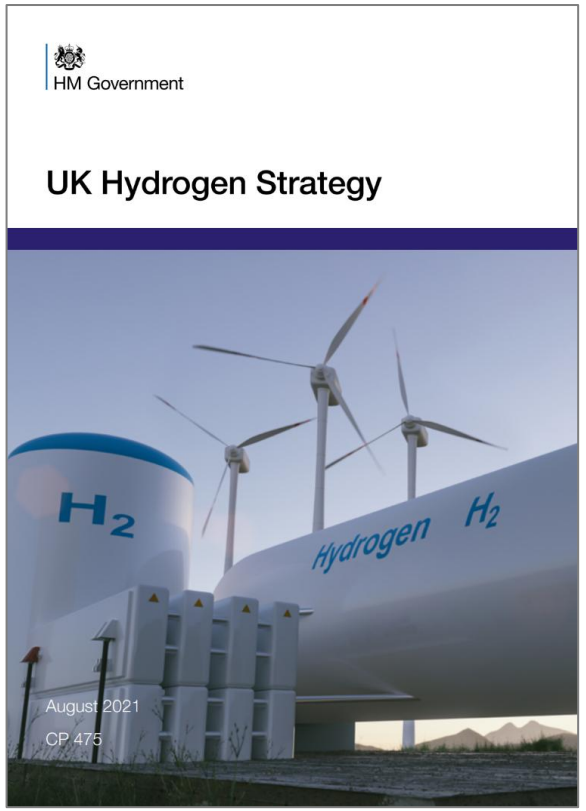
New Siting Policy

- National Policy Statement: EN-6 to EN-7
- Currently in second consultation on the drafting of EN-7
- EN-7 is a key enabler for this project
- Power Plant Siting Study
- Siting assessment criteria are unchanged (e.g. semi-urban criteria)

EN-6	EN-7
Based around large scale reactors	Recognises all, including newer, technology
For projects deploying up to 2025	For projects deploying beyond 2025
Strategic Siting Assessment	Strategic Siting Assessment
Identifies eight locations/sites in the UK where new build nuclear would be considered suitable by UK Government	Moves away from the limitation on eight potential sites and opens options for Government to consider a wider range of sites, hence more flexibility

End Use Policies





Unlocking the Opportunity

equilibrion.

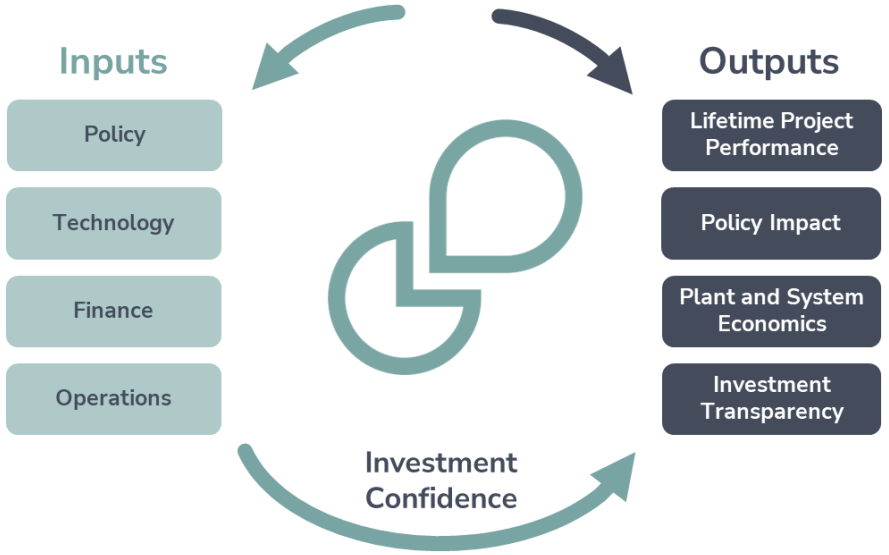
Challenge

Uncertainty in policy and market dynamics complicates long-term project planning where traditional cost models don't capture the benefits of flexible, multi-output configurations

Solution

Specialist techno-economic and policy impact modelling tool, purpose-built from the ground up to integrate the impact of flexible generation on development of new nuclear projects

- Scenario-based analysis allows users to explore outcomes under different market and policy conditions
- Builds investor confidence by demonstrating economic viability across hydrogen, synthetic fuels, and heat applications
- Enables flexible deployment strategies, showing how adaptable design choices can optimise returns



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The low carbon future of aviation

A Growing Problem

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Global aviation is committed to net zero by 2050. Delivering this will require Sustainable Aviation Fuel (SAF).

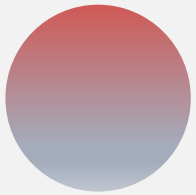
Current solutions for SAF production are:

- Inefficient
- Low-density
- High-cost

eq.flight

The Solution

Use the highest density form of low-carbon energy and optimise its use for zero-carbon fuel production, delivering a **sustainable** and **competitive** SAF pathway



Nuclear energy source of heat and electricity from **small and advanced modular reactors**

Provision of both **heat** and **electricity** drives SAF production technologies at a greatly enhanced efficiency of production

eq.flight

Eq.flight is the engineered system that takes heat from nuclear energy sources and converts it to SAF

One Eq.flight facility can make **177 million litres of SAF per year**

Eq.flight IP is how the use of nuclear heat is applied, scaled and operated to deliver cost effective sustainable SAF solutions

ASTM Compliant SAF

Utilising Heat to Liquid (HtL)™ technology, a subset of PtL, which converts nuclear-derived heat and electricity into SAF, Eq.flight provides the scalable, long-term solution to global SAF production

Nuclear Energy and Sustainable Aviation

Nuclear energy is experiencing a global resurgence, many modern, flexible, smaller designs are in progress, many in advanced stages of design and with increasingly confident deployment plans

91% reduction with a carbon intensity figure of **8.9 gCO2e/MJ LHV.**

Generating footprint of Eq.flight is **51 acres** compared to 66042 acres from wind

Deployment of 12 Eq.flight facilities will create **88,000 jobs**

Positive policy for nuclear SAF in Europe and UK

The application of small modular nuclear reactors to deliver PtL at scale is an exciting market development that enhances the ability to produce cost-effective SAF at scale.

UK Policy Supports Nuclear-derived SAF

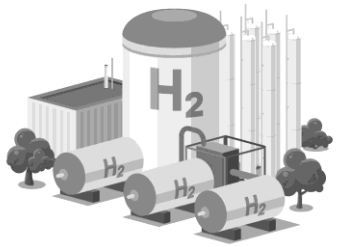
- HMG actively supports nuclear for aviation decarbonisation through:
  - Nuclear energy is explicitly included as a qualifying input within the proposed **SAF Mandate** (2025) and future **Revenue Certainty Mechanism** (potentially due 2027) and **ReFuelEU**
  - Nuclear-derived Fuels included in the UK **Renewable Transport Fuels Obligations**

Summary

- **Policy frameworks** favour the emergence of end-to-end nuclear solutions, policy led solutions needed- nuclear is embedded in UK and EU SAF mandates and low-carbon roadmaps
- **Unlocking new markets** Equilibrion was built to connect nuclear with non-nuclear systems to unlock new markets
- **Equilibrion enables the production of hydrogen, synthetic fuels and heat** from nuclear energy by integrating the technical, policy, and economic solutions needed to deliver fully connected value chains

Upstream

SMRs & AMRs siting & deployment
Policy navigation & licensing
Technical & strategic advisory



Midstream

Heat & electricity conversion systems. e.g.
Integration with H_2 & SAF production tech
Eq.flight™ platform (PtL / HtL™ IP)

Downstream

Hydrogen, SAF, synthetic fuels, DAC
Industrial applications. Global scale
Job creation, cost efficiency, net zero

Nuclear-Hydrogen-Synthetic Fuels-Heat Value Chain

Delivering Investment Confidence to Unlock the market

Thank You

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