HYDROGEN ACCELERATOR

Clean Hydrogen Innovation Programme (CHIP)

02 May 2023

A programme designed to address key challenges identified by the UK Government's Hydrogen Strategy

CARBON TRUST

Disparate forecasts regarding hydrogen production and end use make it challenging for decision makers to plan for the future

Innovation is required to scale up manufacturing capability, improve technical characteristics and reduce cost of hydrogen

The discourse around hydrogen can make it **hard to find the most useful, cost effective role for hydrogen** in the context of net zero

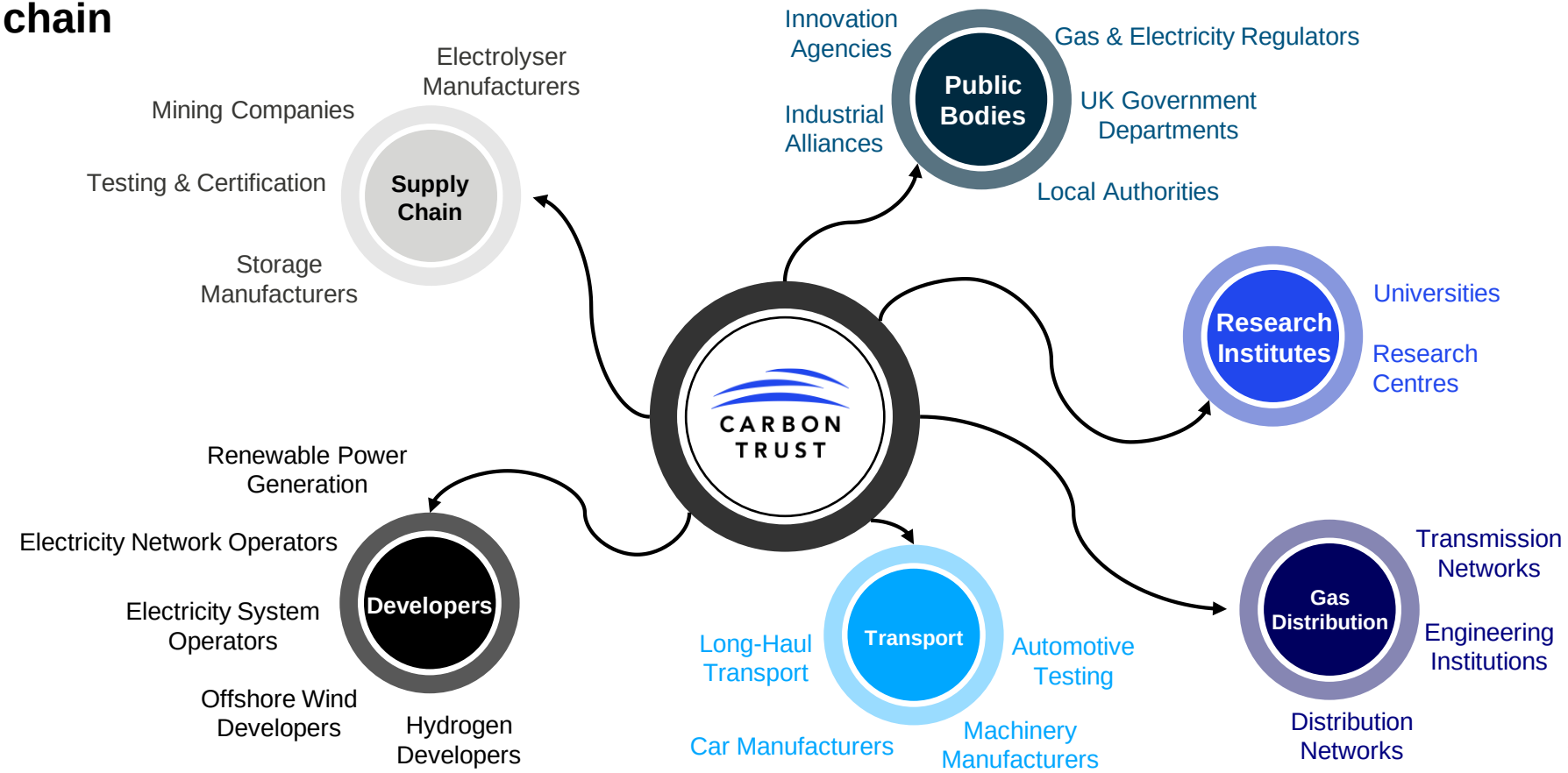
The size of the prize is significant, with analysis suggesting that the **UK hydrogen economy** could be worth up to **£900 million by 2030**

The **UK hydrogen sector could accommodate 9,000 jobs by 2030**, with over 2,000 existing as a result of British supply chain exports

10GW of low carbon production capacity could save **82MtCO_2e between 2023 and 2032**

Quantification of the "Opportunities" comes from the UK Government's Hydrogen Strategy

Throughout the design and development of CHIP, fifty stakeholders have been engaged who represent the end-to-end hydrogen value chain

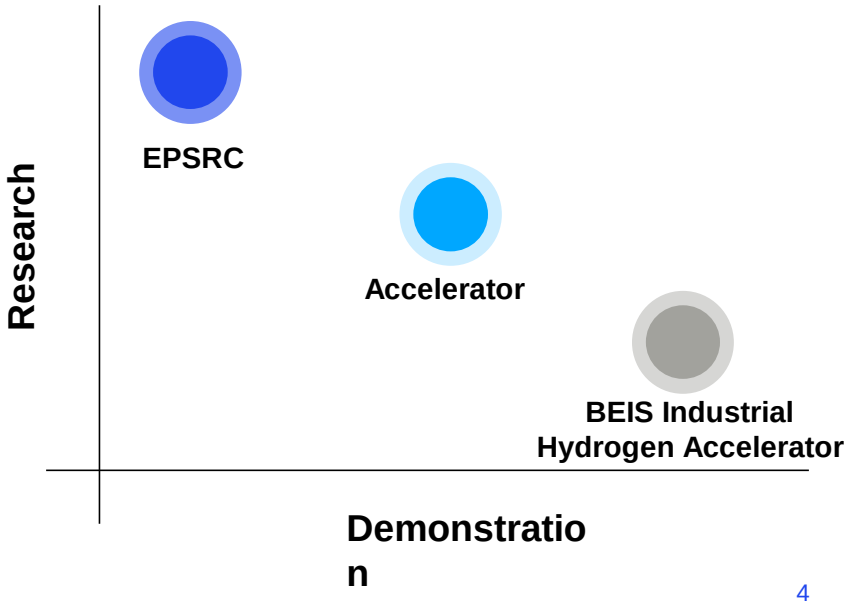


What is CHIP?

CHIP is part of Carbon Trust's Hydrogen Accelerator – a multi-year collaborative research, development and deployment programme. The Accelerator is an industry-led initiative that aims to convene stakeholders to collectively address challenges in the clean hydrogen sector that have cost reduction potential.

Where will CHIP sit in the innovation landscape?

- We have **identified a gap in the development of the clean hydrogen sector**, to collectively identify and address cost reduction opportunities through focused R&D.
- CHIP is **focused on a particular part of the clean hydrogen sector** – the components needed to produce hydrogen, excluding the electrolyser unit itself, and components comprising the storage, distribution and blending/deblending of hydrogen.
- Our programme is unique to other hydrogen innovation programmes. It is a **hybrid research- and demonstration-level programme,** responding to market-pull to bring technology through to commercialisation, **and leveraging public funding in a public-private partnership**



Why do we need CHIP?

One of the largest barriers to developing a clean hydrogen economy in the UK is the cost of clean hydrogen. Whilst the rapid rise in the cost of oil and gas has made clean hydrogen more competitive, *cost reduction is still required to increase hydrogen's deployment across the UK.*

- CHIP will help to address this challenge by **producing an objective innovation needs assessment and prioritisation of key clean hydrogen technologies.**
- The **goal is increasing the cost-competitiveness of clean hydrogen by reducing its end-to-end cost to $2/kg**. This cost is regarded as the tipping point at which clean hydrogen becomes commercially viable when compared with its counterfactuals. CHIP has four objectives:

INNOVATE

Cost reduction will result from **targeting technological innovation** at components where there is the highest cost reduction potential

OPTIMISE

Seeking consensus on innovation gaps maximises use of private/public investment

COORDINATE

CHIP is an industry-led initiative that aims to convene stakeholders to **collectively address challenges in the clean hydrogen sector**

ACCELERATE

Making clean hydrogen commercially viable for more end-users will accelerate its deployment

CHIP will bring demonstration level technology to clean hydrogen

The high end-to-*end cost of clean hydrogen is one of the main barriers to its use. CHIP's focus is to reduce* the cost of clean hydrogen through targeting technological innovation at components where there is the highest cost reduction potential.

Four areas included in the preliminary scope of CHIP:

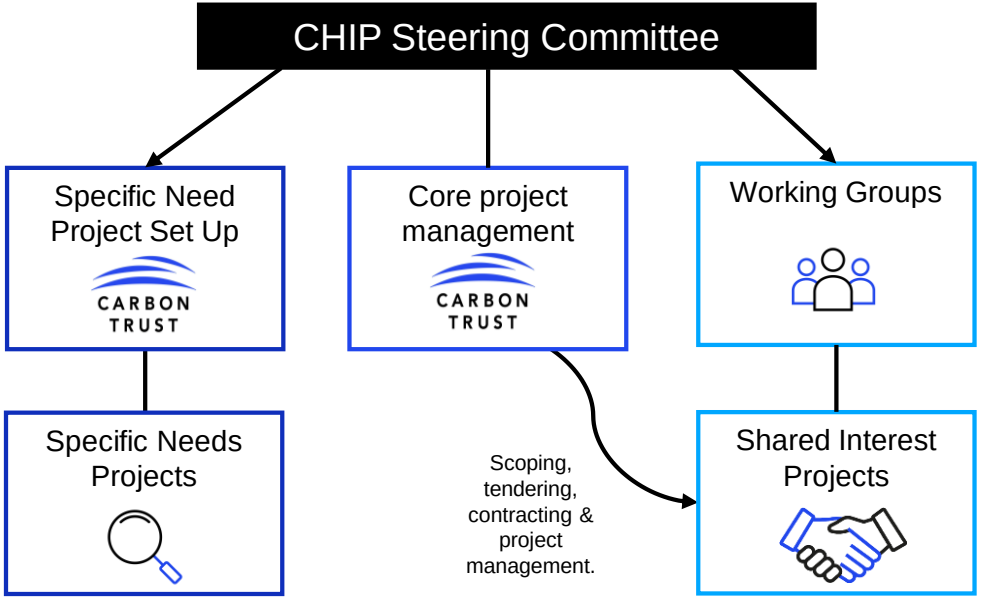
Purification	Compressors
How can water purification be more efficient? How can we reduce water use? Which are most appropriate solutions for hydrogen purification (eg membranes, PSAs, TSAs)? Could hydrogen purification use membranes?	Could electrochemical compression be integrated with an electrolyser more efficiently? Could we combine hydrogen purification units with compression units (eg PSA/TSA and compressor)?
Storage & Distribution	**Valves, Seals, Pumps, Pipes and Meters**
How can we make tube trailers lighter? How could hydrogen's delivery pressure be safely increased? Which end-use cases are most suitable for tube trailer storage? What are the required dispensing solutions (eg bowsers)?	How to make these elements compatible with hydrogen? How can we reduce embrittlement? What is the best design for hydrogen meters, including safety measures?

- The scope has been refined to include all **balance of plant (BoP) components** and components needed to **store**, **distribute** and **blend/de-blend** hydrogen.
- These **areas have been chosen based on their high potential for cost reduction** and/or low efficiency.
- Technology within the electrolyser is excluded to avoid manufacturer intellectual property issues.
- The questions represent potential technological improvements to be made via CHIP, alighted on by desktop research and stakeholder consultation.

CHIP will follow an industry-led accelerator model approach

The Accelerator is an industry-led initiative that aims to convene stakeholders to collectively address strategic challenges in the clean hydrogen sector and develop high-impact solutions. CHIP and its resulting projects will target areas of shared interest, while also targeting specific needs at points along the value chain.

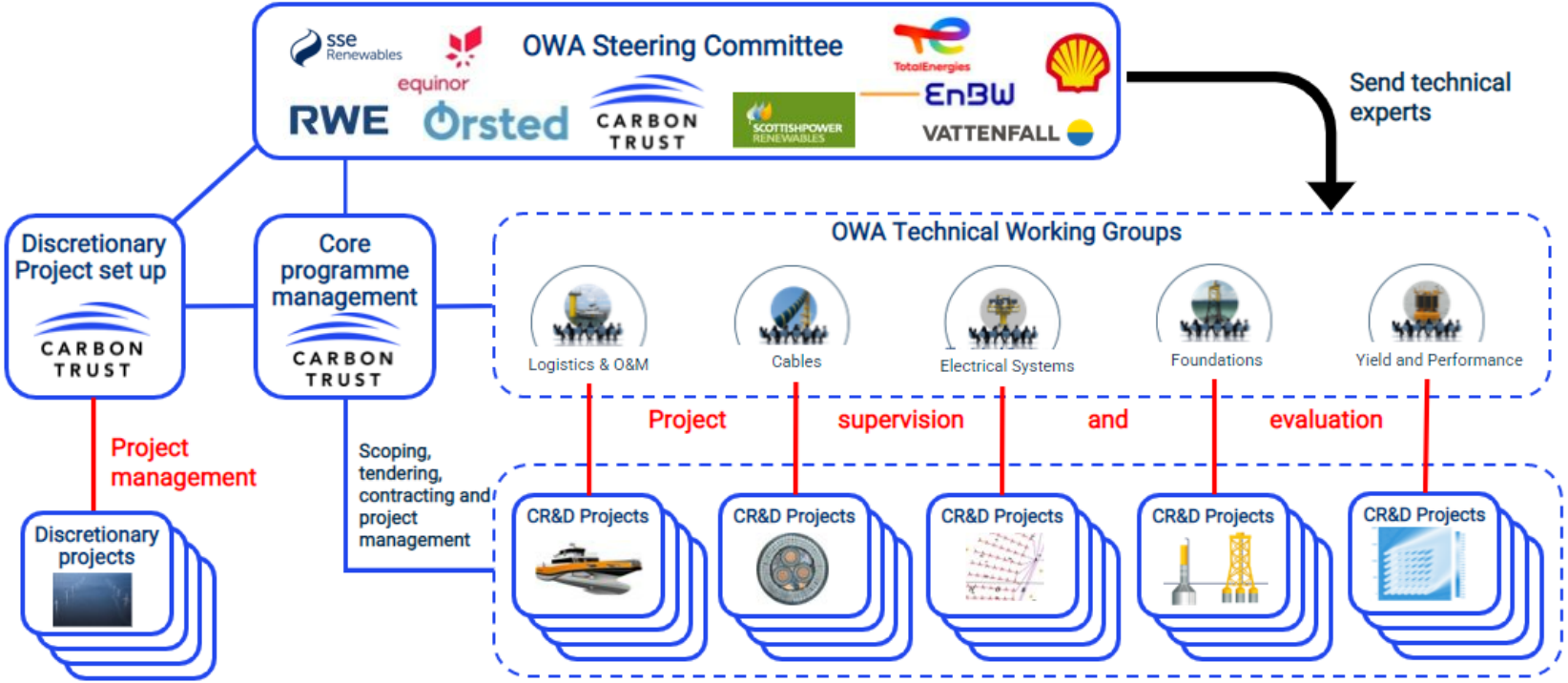
The operational mechanics and governance of the Accelerator:



The benefits of this accelerator model include:

- Sustained industry engagement
- Co-created with industry, needs based
- Pooling knowledge and skills
- Stimulation of supply chain solutions
- Sharing costs and leveraging funding
- Reducing R&D risk

CHIP's operational mechanics and governance is based off the highly successful structure of the Offshore Wind Accelerator:



As seen in the offshore wind sector, Carbon Trust's accelerator approach can have significant sector-wide impact

>185 projects

£105m

+200 stakeholders

+70 organisations

+80 workshops/conferences

+320 meetings

£34bn overall savings

-15% average LCOE impact