Nurturing a strong and innovative H2FC industry in the UK

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Industrial Strategy

Five foundations:

- Ideas - R&D
- People - skills
- Infrastructure
- Business environment
- Places

Two relevant Grand Challenges:

- Clean growth
- Future of Mobility

Currently, there is one mission currently for each challenge (e.g. halving the energy use of new buildings by 2030).

ISCFs provide smaller-scale support to consolidate existing activities.

Questions addressed by the report

1. How might H2FC technologies contribute to achieving long-term energy goals?

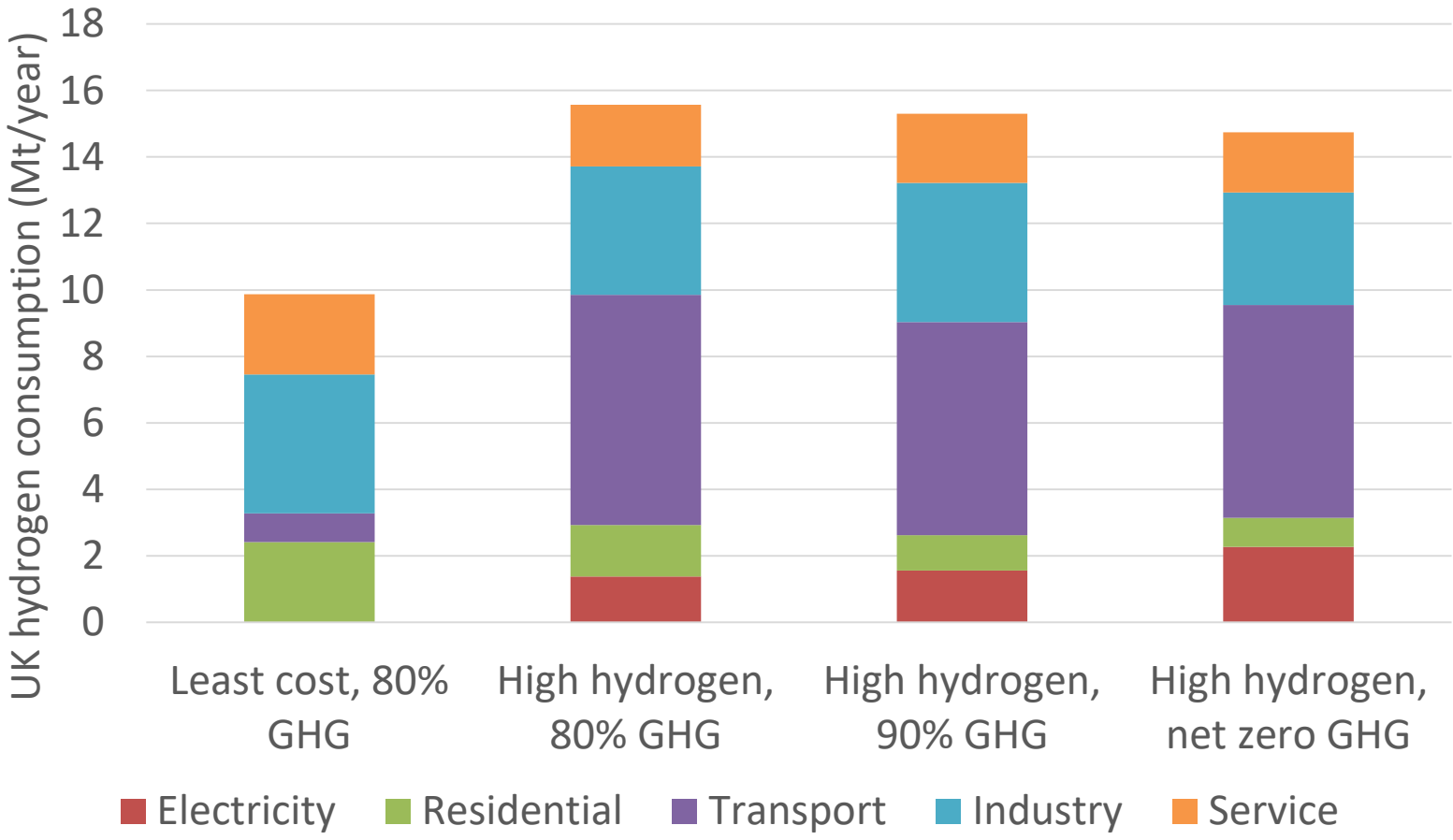
2. What is the research and innovation capacity of the UK H2FC community?

3. What are the potential benefits and opportunities for the UK?

4. What actions are necessary to encourage a successful innovation ecosystem?

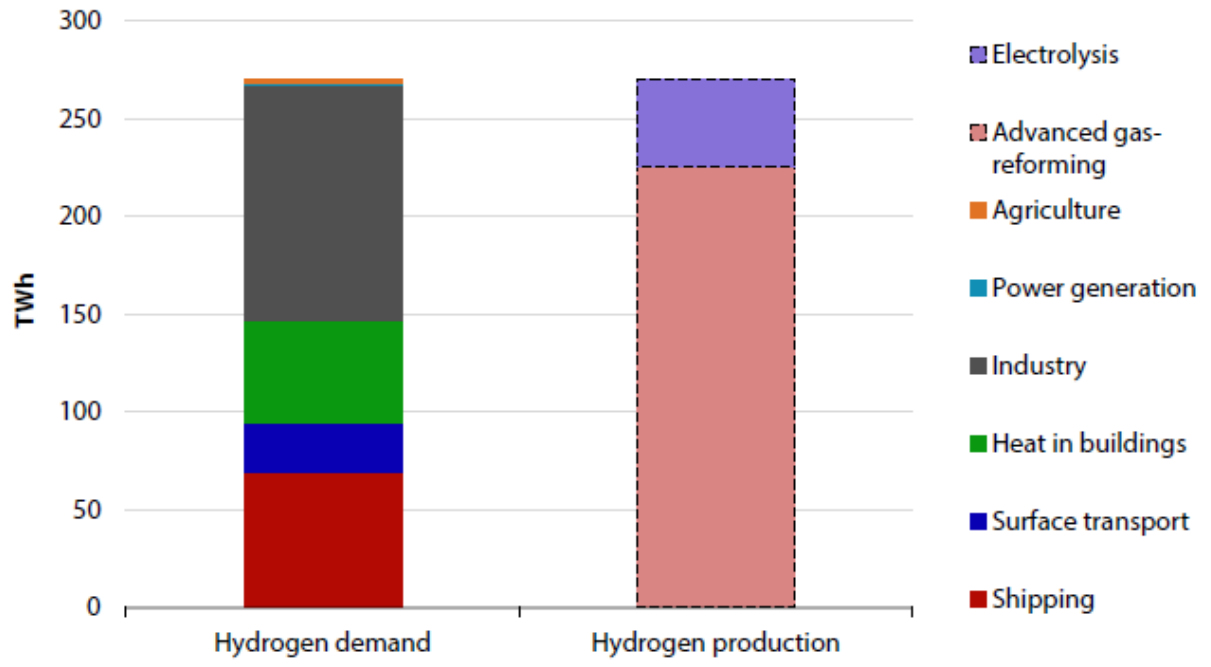
1. How might H2FC technologies contribute to achieving long-term energy goals?

Our energy system scenarios suggest UK hydrogen demand in 2050 of 10–16 Mt



The CCC foresee roles for hydrogen across the energy system

Figure 2.8. Use and production of hydrogen in the Further Ambition scenario (2050)

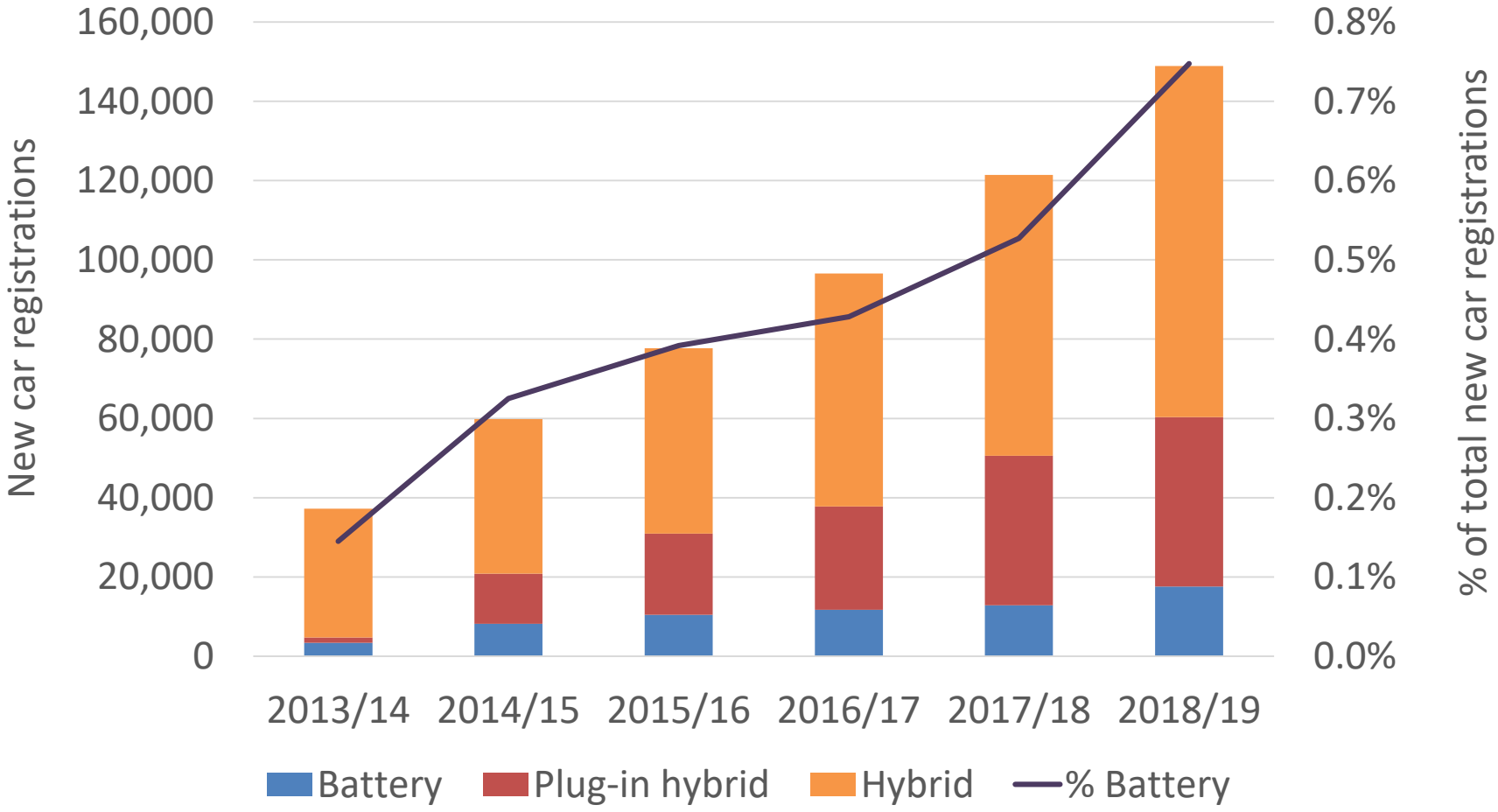


Source: CCC analysis.
Notes: Our analysis assumes the majority of future hydrogen production in the UK is from advanced methane reformation with CCS (225 TWh), with a limited contribution from electrolysis (44 TWh).

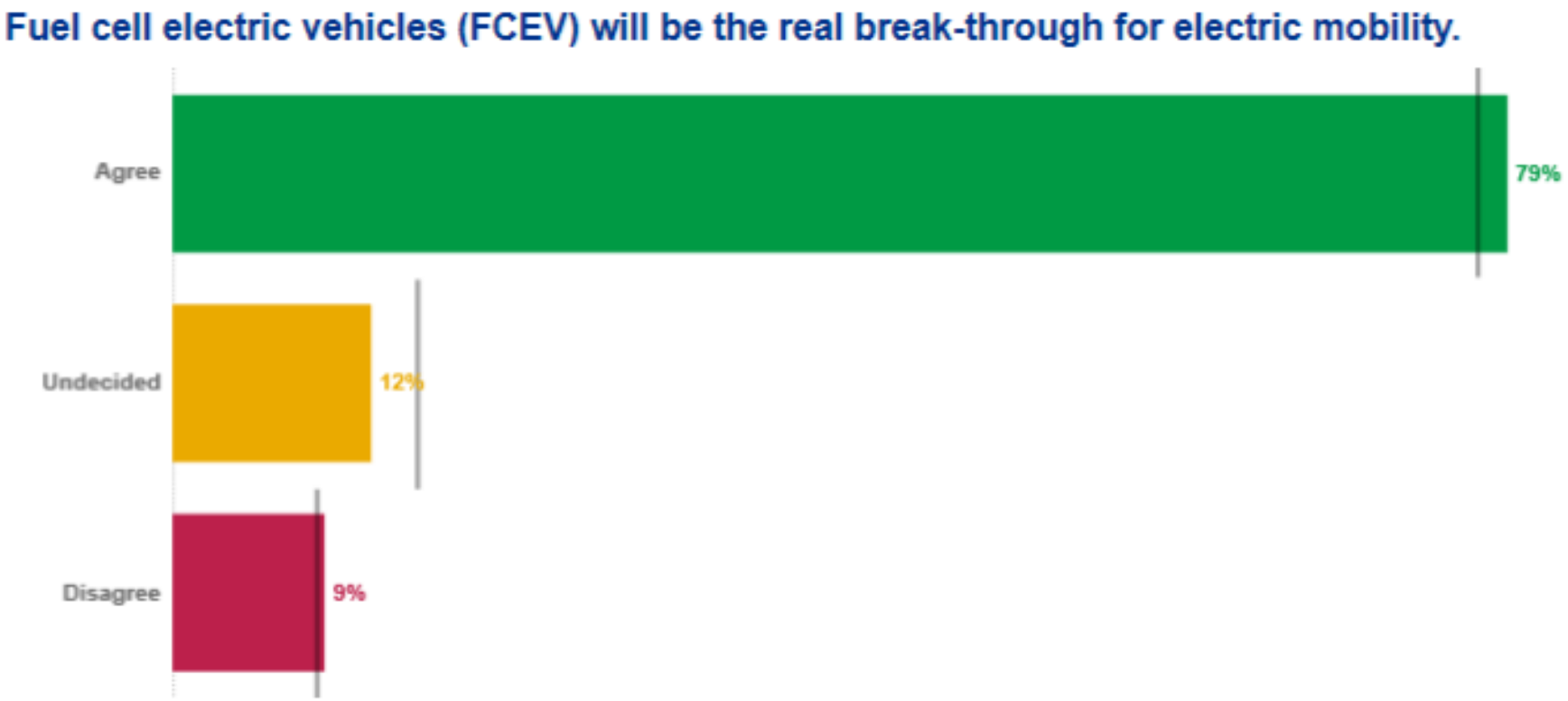
Future UK market for hydrogen

- Current UK hydrogen demand: 0.7 Mt
- UK hydrogen demand in 2050: 3–18 Mt
  - Heavy duty vehicles
  - Industrial processes
  - Possibly a wider role in transport, heat provision, and electricity generation
- Global hydrogen demand in 2050: 500 Mt

Battery cars have not (yet) cornered the UK market

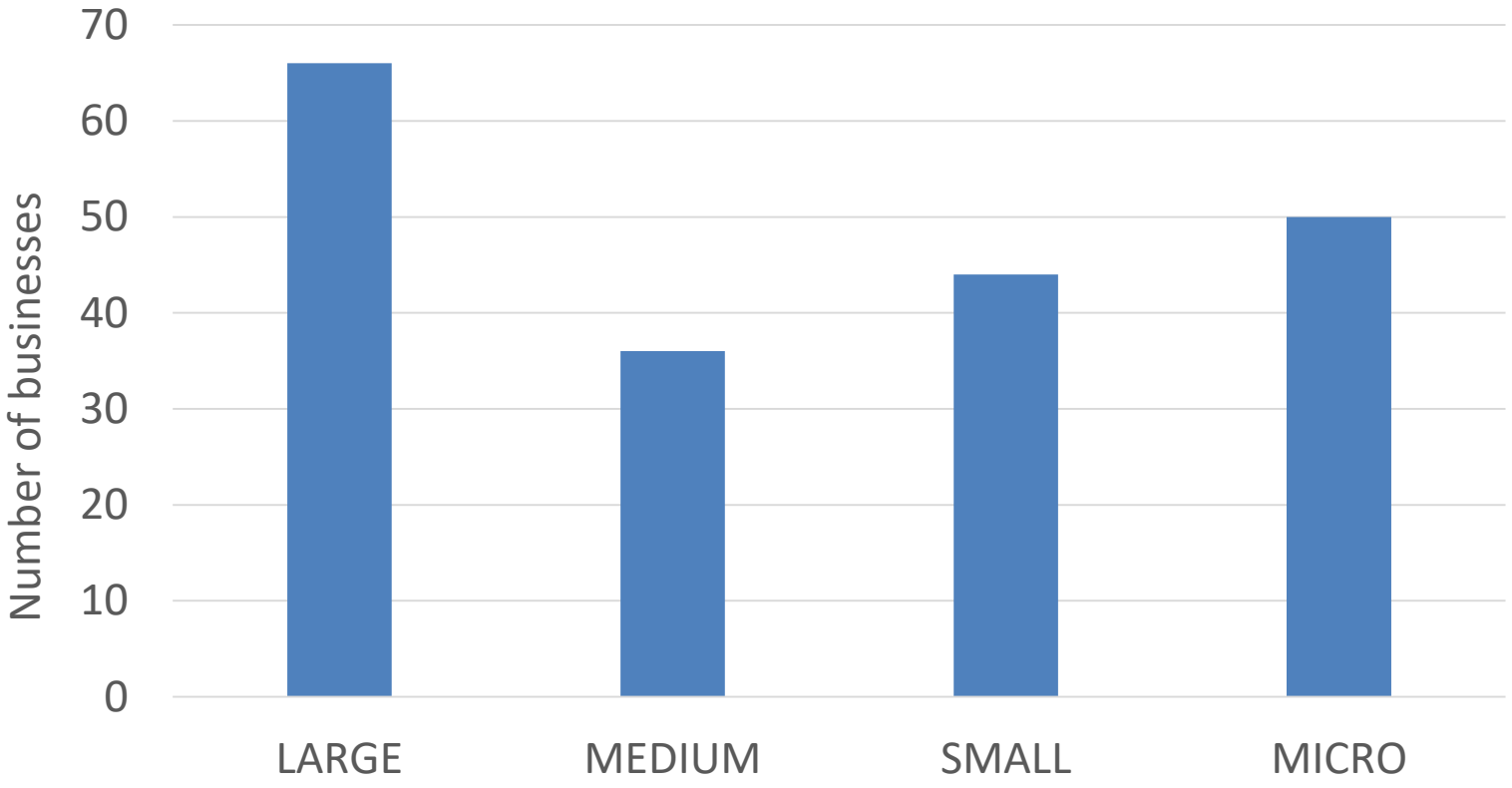


The KPMG Automotive Survey 2019 concluded that FCEVs could be the real break-through for electric vehicles

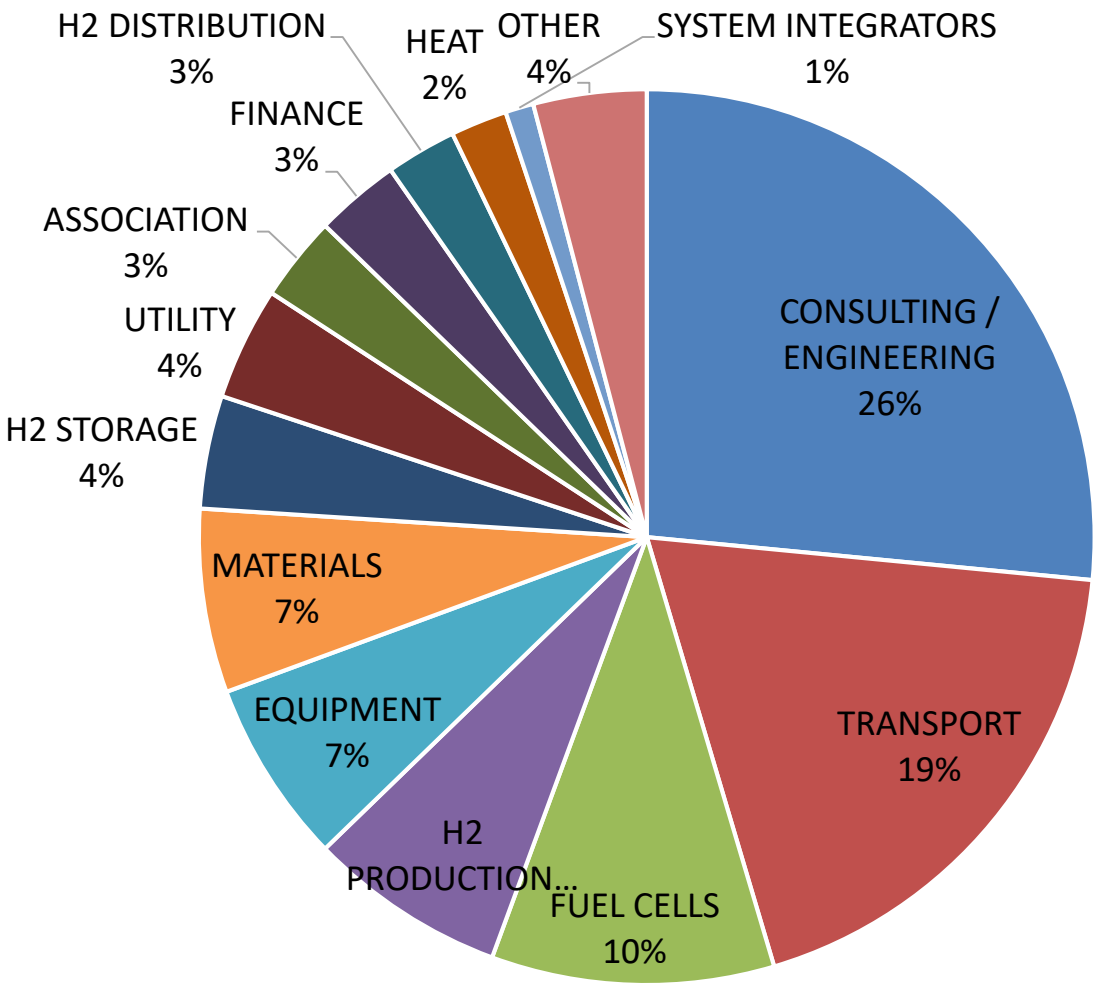


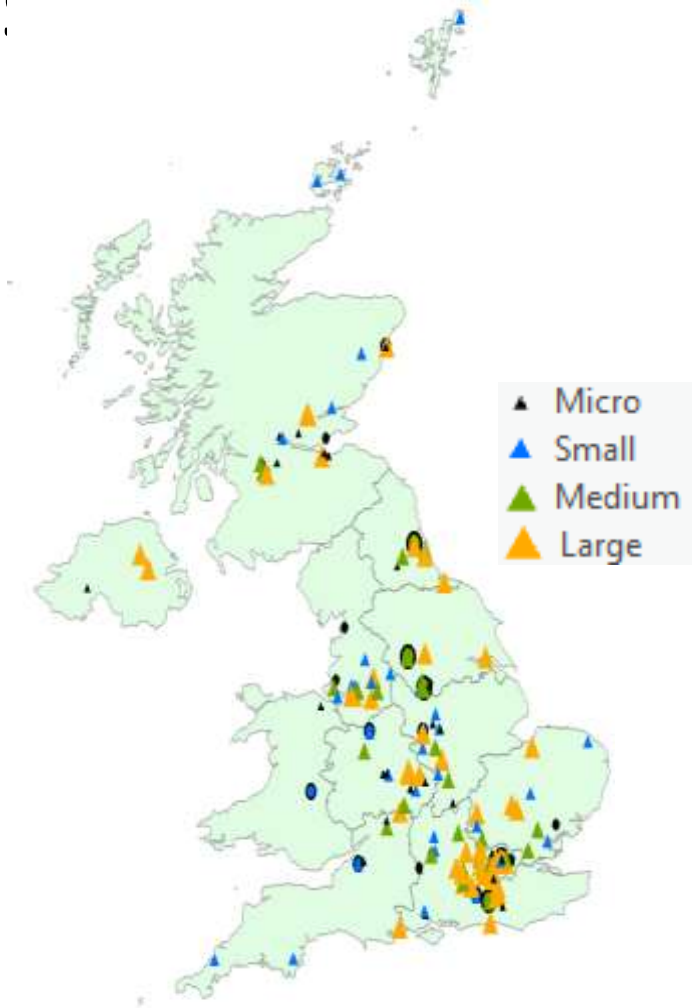
2. What is the research and innovation capacity of the UK H2FC community?

We identified around 200 businesses actively working with H2FC technologies in the UK



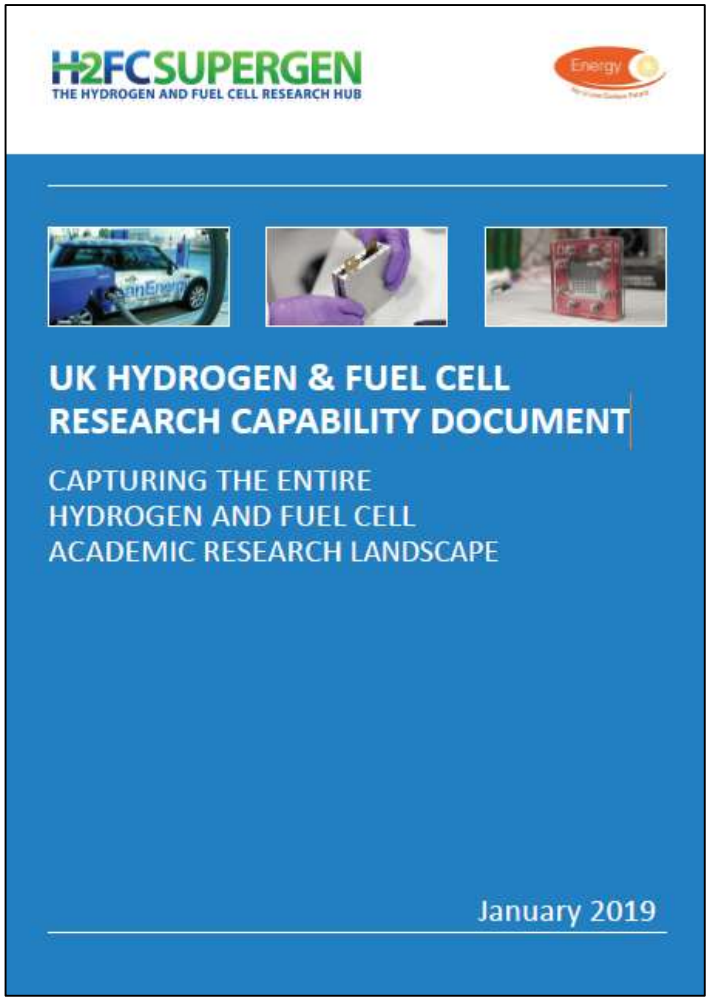
UK businesses work across a wide range of area



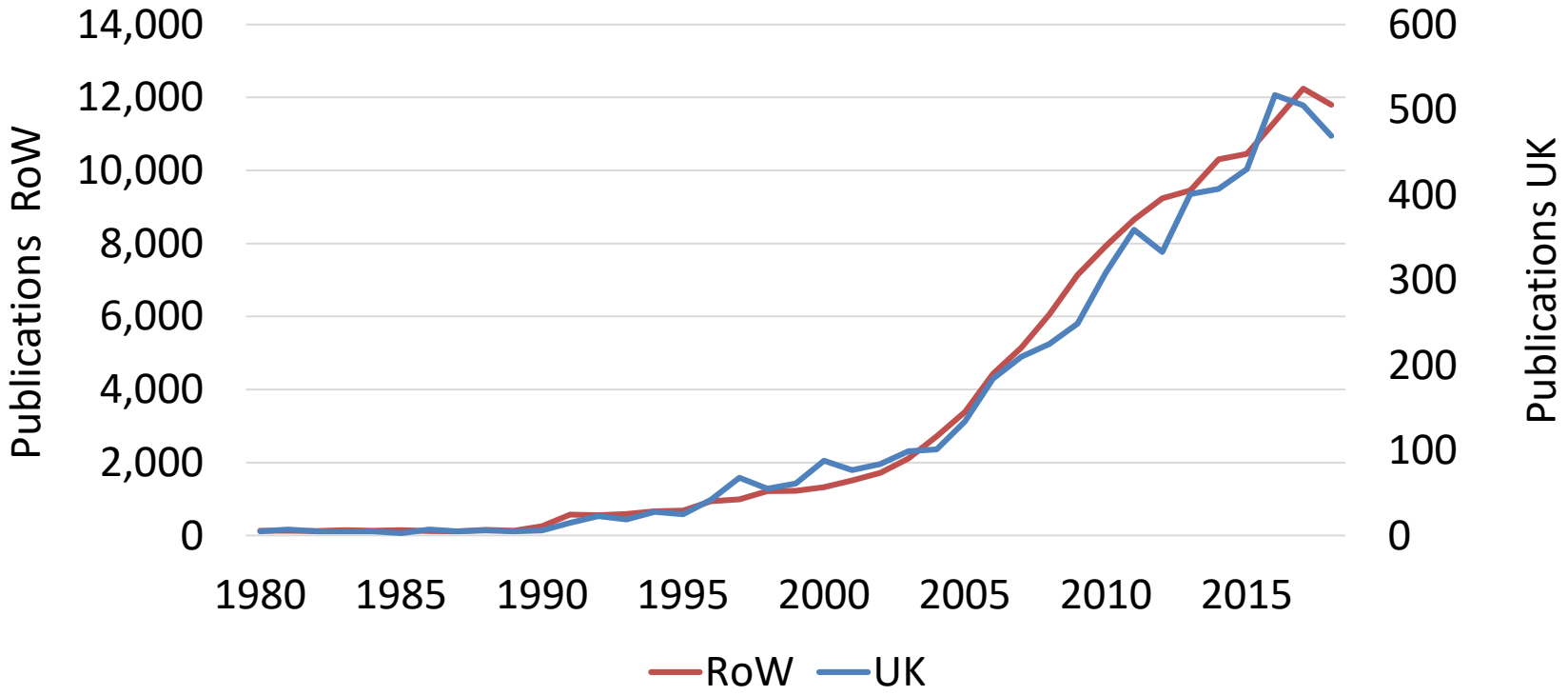


UK academic research capacity

Research area	Universities
High temperature fuel cells	10
Low temperature fuel cells	12
Hydrogen production	11
Hydrogen storage and safety	10
System design, modelling and socioeconomic analysis	10

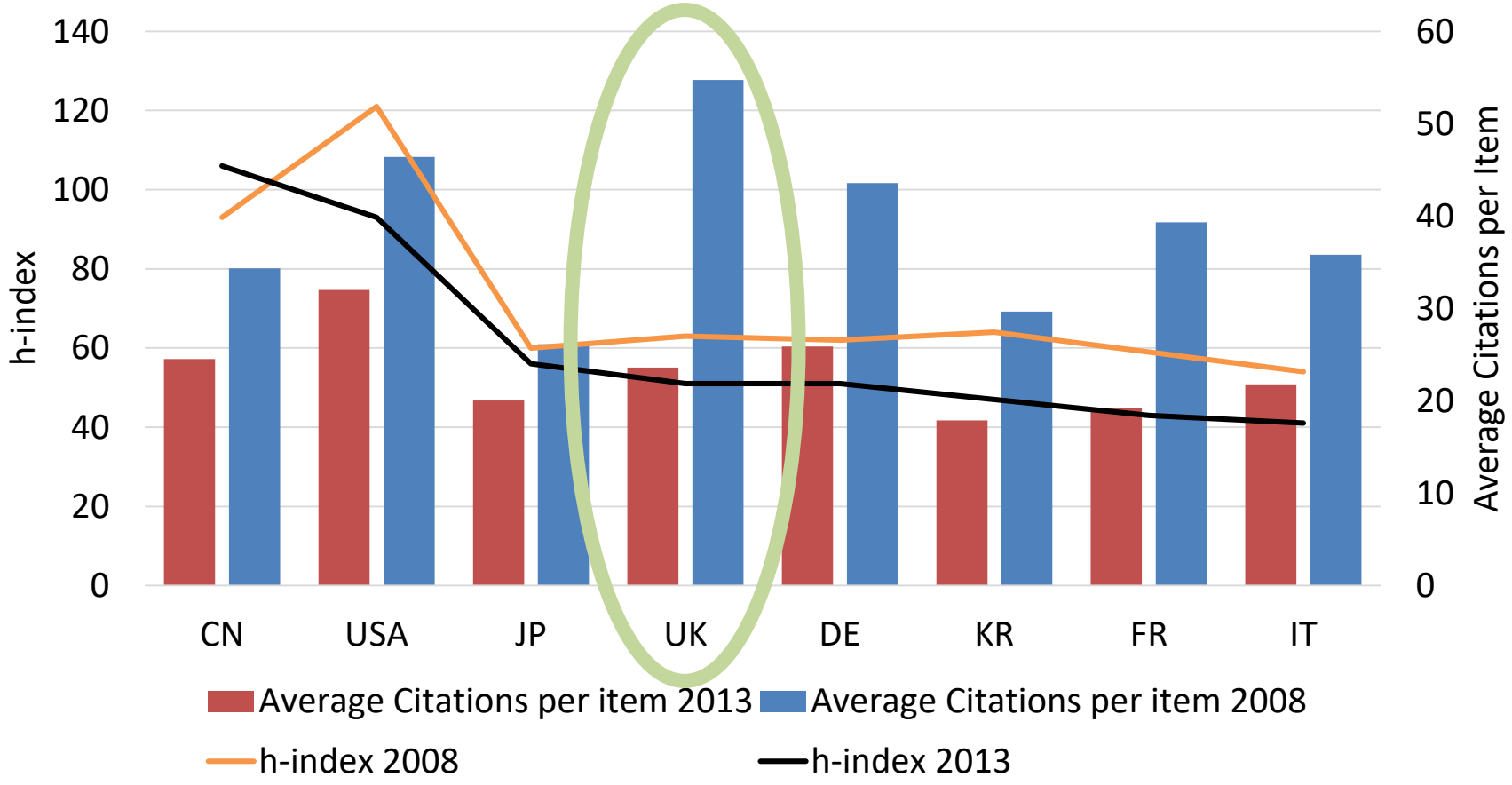


Research base – UK journal publications

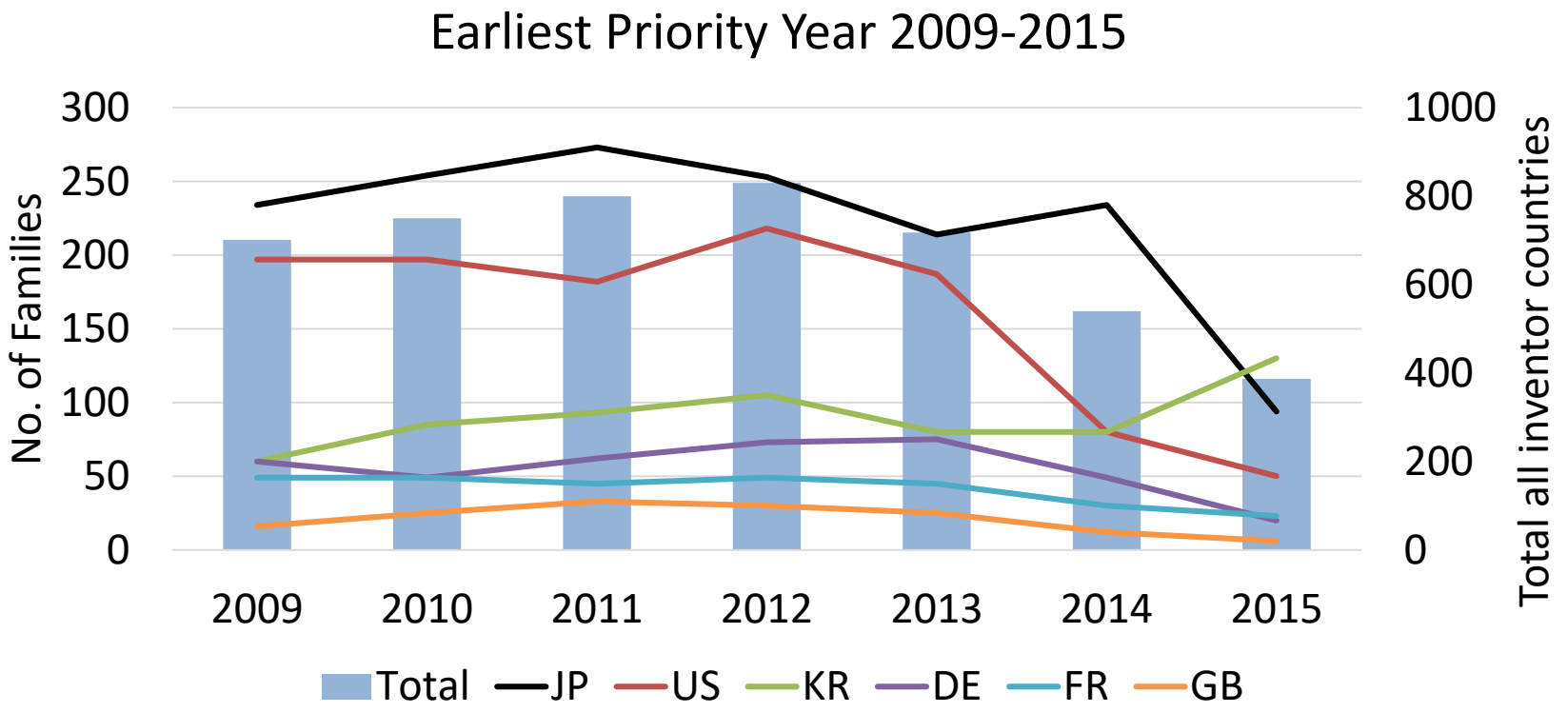


UK has followed global trends - but UK volume of publications much lower than US, China & Japan, and behind Germany & South Korea

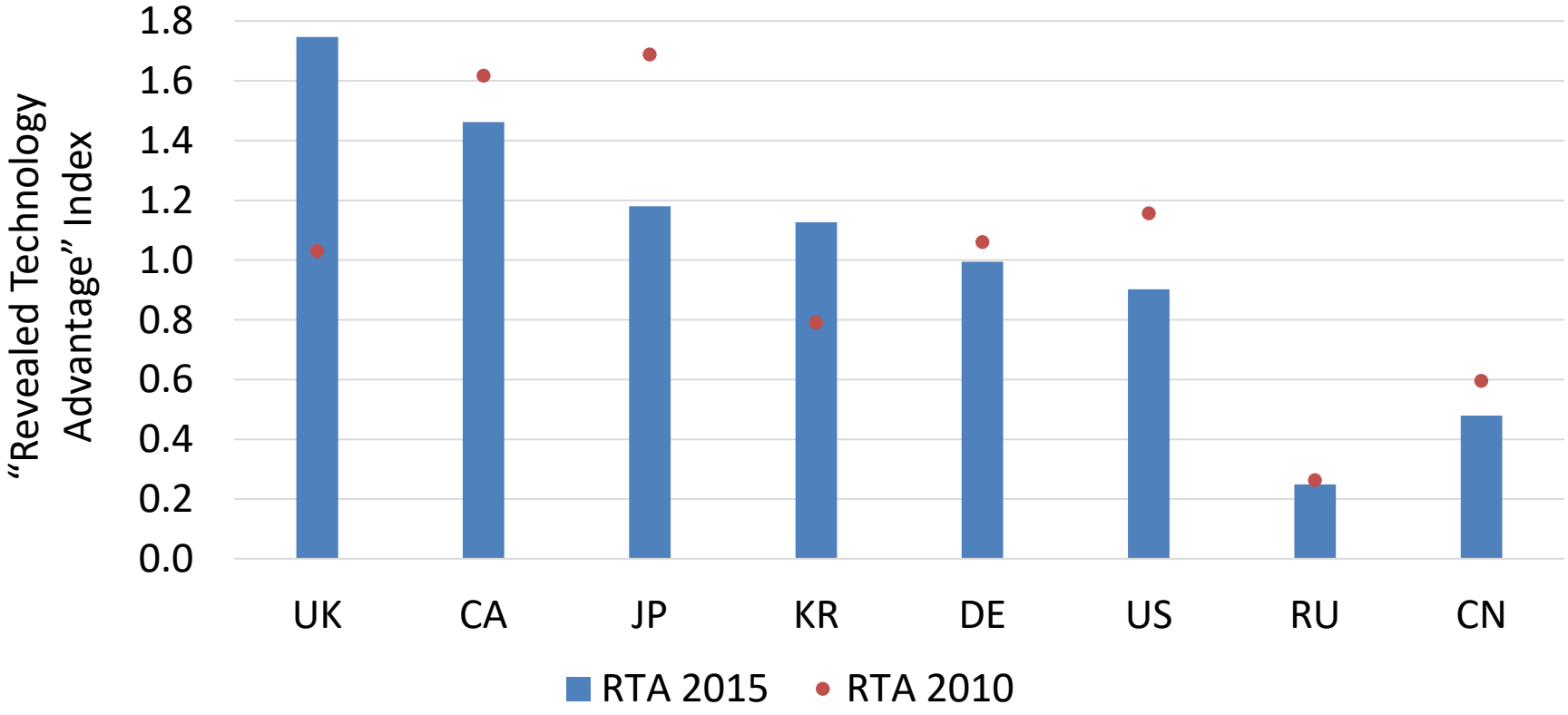
Research base – journal paper citations



The UK is within the top ten countries at patenting H2FC technologies, but far behind Japan and the US



The UK is more successful in generating patents for H2FC than for other energy technologies

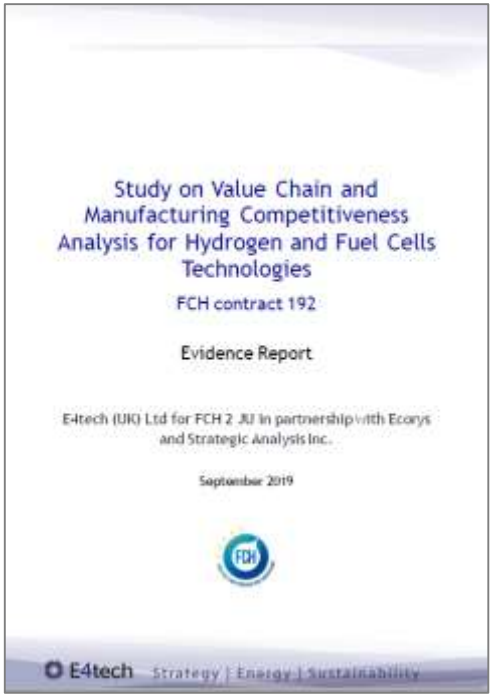


3. What are the potential benefits and opportunities for the UK?

Some benefits to society could be realised through investing now

Environmental damage costs for Euro 5 vehicles:

There are larger potential economic benefits in the longer-term



EU: €9–11bn/year in 2030

Infrastructure is important

£1 petrol = £1.50 economic activity

£1 hydrogen = £2.50

Clean growth opportunities

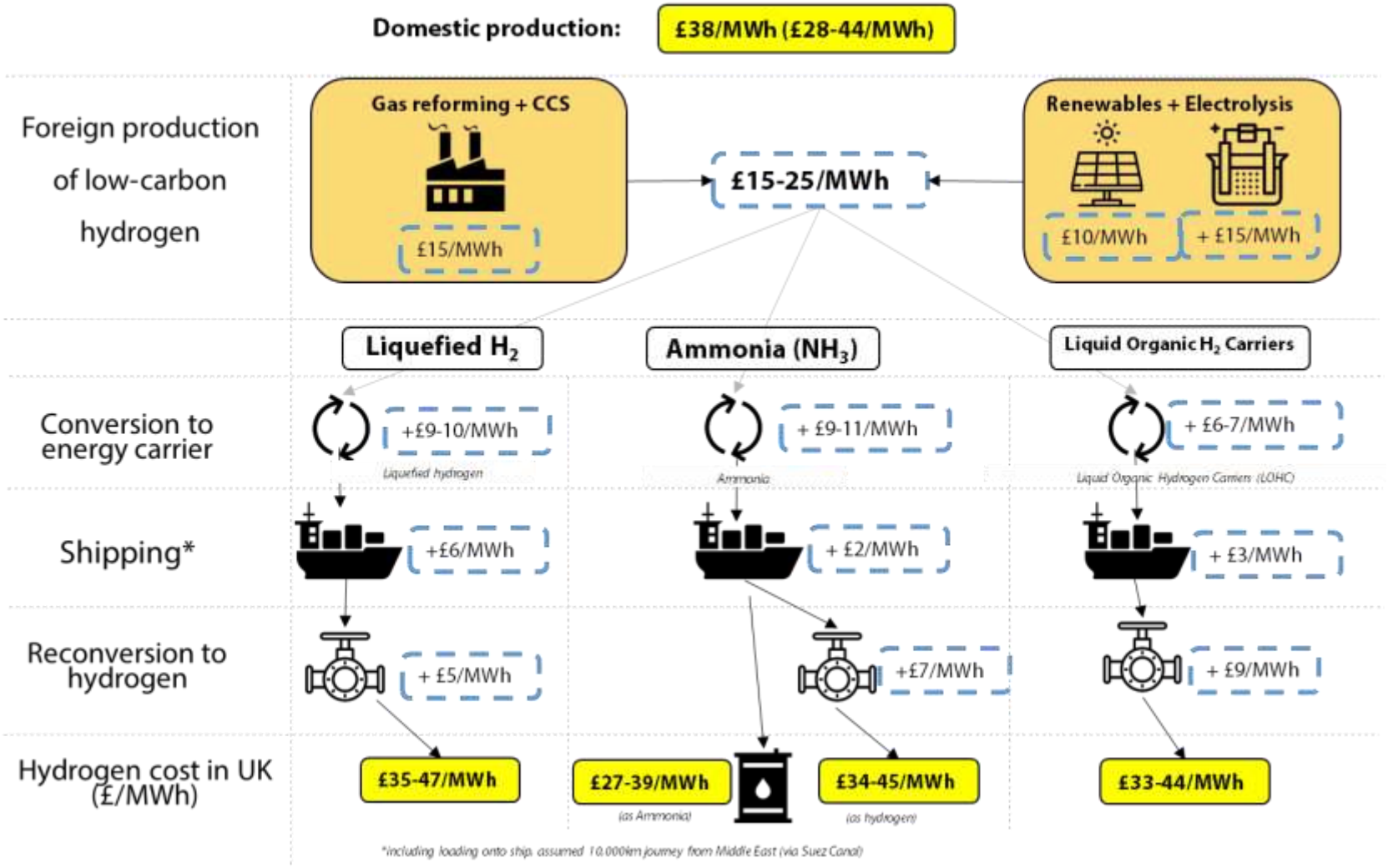
1. Where the UK has strength in existing technologies
   - e.g. engine and car manufacturing industry, with a skilled workforce
2. Strength in novel H2FC technologies
   - e.g. electrolysers; micro-CHP; materials; engineering.
3. Strength in related low-carbon technologies
   - e.g. spill-overs from battery mobility to support fuel cell development.

There will be different levels of international competition in each sector

Less international competition

More competition

The CCC do not see the UK being undercut by international hydrogen trade



4. What actions are necessary to encourage a successful innovation ecosystem?

A successful innovation ecosystem requires …

- a sufficiently large skilled and innovative workforce;
- a diverse range of firms that interact both through competition and cooperation;
- sufficient funding and other support to underpin R&D;
- an appropriate regulatory and institutional framework;
- demand for products.

Sector sentiment

Weaknesses

- Weak policy support for H2FC
- Access to finance
- Slow and bureaucratic funding processes and decisions
- Availability of skills

Strengths

- Quality of R&D resources in universities
- UK firms globally networked in their R&D activities

Concerns

- Brexit
- Chinese investment will result in leakage of UK IP
- UK may fall behind if policy support not forthcoming

Opportunities

- Half of firms are competitive and very optimistic about the future
- Optimistic about the sector (but strongest growth potential overseas)

There is a need for supportive institutions

Proposer	Institution function
H2FC Hub	Hydrogen Institute – a large, coordinated academic H2FC programme
UKRI RIIR	Centre for the study of hydrogen use and safety of devices
UKRI RIIR	A facility to develop bulk production of low-carbon, low-cost, resilient hydrogen
UKRI RIIR	A research centre into the use of hydrogen in the gas grid, as an admixture or as 100% hydrogen
UKRI RIIR	A centre to research and develop the underground storage of hydrogen
UKRI RIIR	A research institute for fuel cells for the improvement of performance and reduction of cost
UKRI RIIR	A centre to facilitate the transition from a natural gas economy to a hydrogen economy

Draft suggested actions

1	Commission damage cost calculations to better identify niches that are particularly suited for early adoption of low-carbon technologies.
2	Explore whether the UK could take a strategic lead in the design and construction of low-carbon, heavy-duty vehicles such as buses, refuse collection vehicles and urban delivery HGVs.
3	Identify and create a strategy to construct the minimum level of infrastructure required to underpin a future hydrogen and fuel cell market, involving public and private capital as appropriate.
4	Examine opportunities to use low-carbon hydrogen in oil refining, ammonia and methanol production, and elsewhere, as part of the new ISCF industrial decarbonisation challenge.
5	Commission an input-output or CGE model study to test the assumptions made by the H2FC Hub study and to widen the analysis to other H2FC areas.
6	Understand whether the UK is likely to have a comparative economic advantage over other European countries for hydrogen production.
7	Understand whether a UK hydrogen production industry could be undercut by imports of low-carbon hydrogen, or hydrogen-based compounds, by ship.
8	Estimate the potential economic benefits that might be lost through not developing substantial domestic H2FC industries, including the potential loss of exports.

Draft suggested actions

9	Assess potential compositions of a robust H2FC innovation ecosystem.
10	Better articulate the ramifications of H2FC being adopted in the UK, in different ways, in the long term.
11	Ensure there are mechanisms for UK researchers and companies to continue and build on existing collaborations with European counterparts, and access European markets.
12	Analyse the economic implications of methods of creating a UK market for H2FC technologies, including through public procurement and/or carefully chosen subsidies, and produce a plan for market development.
13	Ask the national infrastructure commission to produce an assessment of hydrogen infrastructure needs.
14	Assess the cost implications of planning H2FC deployments to primarily replace existing technologies when they reach end of life, so avoiding early retirements.
15	Assess the cost implications of mandating dual fuel boilers for heating, perhaps through the Hy4Heat programme, and proceed to a community trial if there are no substantial technical or economic impediments.
16	Assess whether strategic support to nurture an H2FC innovation ecosystem is appropriate for the UK.

Draft suggested actions

17	Assess the implications of a more coordinated innovation approach to H2FC by the UK.
18	Consider the implications of joint research projects in which resulting IP is shared between participating UK stakeholders, similar to the approach taken in Japan.
19	Review and refresh the UK H2FC roadmap.
20	Consider how to strengthen H2FC innovation in regions where large investments might occur but H2FC activity is currently relatively weak, such as Wales and the North.
21	Consider whether any of the six potential research centres identified by the UKRI Research and Innovation Infrastructure programme, or a separate “Hydrogen and Fuel Cell Challenge” institution, should be pursued.
22	Assess whether a more coordinated funding approach to H2FC could encourage the development of an innovation ecosystem.
23	Consider whether the current funding structure is optimal for potentially large industries that are developing over long timescales.
24	Produce annual reports on the health of the UK H2FC innovation ecosystem, using relevant metrics (patents) and company-specific information.

Conclusions

- There are opportunities in heavy duty vehicles and hydrogen for heating where the UK has both demand and skills.
- The UK has a globally-competitive H2FC sector with a world-leading science base.
- The business environment risks failing to incubate the sector into a successful innovation ecosystem, and is causing the UK to fall behind other countries.
- There is an opportunity to create new H2FC industries, and economic and employment growth, but these industries will require careful nurturing and support from the public sector.
- There is some misalignment tension between optimal hydrogen end-uses, industrial and academic comparative advantage, and UK H2FC growth opportunities. So what does the UK want?

Thanks to:

- Stakeholders who have contributed to the project
- Everyone who has already or plans to comment on the draft report
- All of you, for listening!

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