Report

UK Hydrogen Fuel Cell Electric Heavy-duty Vehicle Supply Chain Review

National Composites Centre
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Executive Summary

Decarbonisation of heavy-duty vehicles is critical to meeting the UK Government's zero emission targets by 2050, requiring significant national coordination. It is widely recognised that pure battery electric solutions are unlikely to meet the requirements for the majority of long-haul, heavy-duty applications. Fuel Cell Electric Vehicle (FCEV) technology is in early stages of deployment with the potential to serve this unmet need.

According to a recent study from the Connected Places Catapult, to meet zero-emissions by 2050, sales of non-compliant HDVs will need to cease by 2040. To develop a fully competitive vehicle marketplace with supporting refuelling infrastructure by 2040, key decisions on technologies to deploy at scale would need to be made by 2027.

This presents a significant market opportunity for the supply of UK FCEV powertrains as most components are currently sourced from businesses in North America or the EU. Sufficient time is available for the UK to develop large-scale pilot projects demonstrating FCEV technology in real-world applications and establish effective coordination of supply chain actors, including encouraging UK OEMs to prioritise the integration of UK-supplied technology in order to stimulate early markets.

To identify UK FCEV supply chain opportunities, this project, funded by the Automotive Transformation Fund (ATF) delivered through the Advanced Propulsion Centre (APC), set out to identify key stakeholders, capability gaps, strengths and weaknesses.

Arcola Energy is a leading developer and vehicle integrator of FCEV powertrains systems. Using Arcola's FCEV powertrain technology platform as a baseline for current and upcoming technology requirements for heavy-duty applications, the project team launched a supply chain survey in January 2021. Additional support was also given to the survey by further desk-based research. The survey encouraged responses across product information, current and planned production capacity, manufacturing and commercial readiness levels as well as perceived technology and supply chain gaps around the specific critical powertrain components.

Over a period of two months, the study has captured approximately 175 industrial actors, some with existing operations and others with latent capabilities in the FCEV powertrain market. The results show that there are specific performance and technical requirements for FCEV powertrains that present an open innovation opportunity that could be met by relevant capabilities of UK suppliers.

Key areas of opportunity and supply chain strength include hydrogen storage, PEMD and high-power batteries. However, it is clear that investment in R&D, vehicle deployment and infrastructure together with supply chain coordination is necessary for the potential of the UK supply chain to be realised. With decisions on technology selection required by the end of the decade, there is a window of opportunity for the UK to capture significant value in a key zero-emission vehicle sector with global potential.

UK Hydrogen Supply Chain Opportunities Survey

Hydrogen fuel cell electric powertrains are expected to play a significant role in the transition of heavy-duty vehicles (HDVs) to zero emissions. This opportunity - and its targets - are recognised in the Automotive Council's Fuel Cell Technology Roadmap, recently published by the Advanced Propulsion Centre (APC).

The current UK market for HDVs (including trucks and buses) is approximately 40,000 per year, all of which are expected to switch to zero emissions in the next 15-20 years. Of this, Fuel Cell Electric Vehicles (FCEVs) could take between 25% to 50% of this market segment. With the average battery capacity for these systems being around 50kWh, this is a total futu the UK alone of 500MWh to 1GWh per y through export and into trains and off-

H2

High Power batteries

Hydrogen storage

Power electronics, motors and drives

Thermal management, HVAC and auxiliaries

Fuel cells

Control systems, data and digital services

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Introduction

At present, reliance on battery technology alone is not sufficient to meet the government's zero emissions targets in the outlined timeframes, this is especially true for long-distance heavy-duty applications.

Arcola Energy is a UK-based hydrogen fuel cell powertrain integrator involved in the development and deployment of FCEVs in the UK and abroad with a specific focus on commercial vehicles. Arcola's ambition is to play a significant role in the uptake of this technology and, to this end, it is developing its own full "tank-to-wheels" powertrain platform. Currently, much of the sub-systems in the powertrain solution are sourced from abroad with currently no viable UK supply.

This project aimed to investigate the feasibility of scaling up FCEV powertrain solutions for HDVs and understand the requirements for building the associated supply chains in the UK. As such, the project looked to understand the technical and commercial barriers for local supply, directly supporting the overall objectives of the ATF to establish a competitive and sustainable UK supply chain.

Arcola Energy's powertrain platform has been applied across several heavy-duty vehicles including buses, trucks and trains; and Arcola's powertrain modelling capability allows the exploration of requirements across a wide range of vehicle types. This background knowledge was used in the project to identify critical and high-value components and to provide benchmark performance requirements based on currently available off-the-shelf subsystems and projected requirements for future systems, for example for larger vehicles.

The project consortium is led by Arcola Energy and NCC with strategy consultants E4Tech supporting Arcola with market and business analysis. The NCC, acting on behalf of the wider catapult network, has coordinated the access to this extensive knowledge-base to carry out a detailed UK supply chain mapping activity to identify key gaps and potential solutions.

Market Overview

The total UK market for heavy-duty vehicles is around 50,000 units in the UK and 320,000 across the EU. This is expected to increase by 10% to 2030. Global sales are around 2m per annum. The largest market segment is articulated trucks accounting for about 45% of the total. Rigid trucks over 16t have around 35% market share with the balance made up of trucks above 3.5t and buses.

Apart from the articulated truck segment, the market is made up of multiple vehicle variants, body types and use cases that are large enough to sustain their own manufacturers and supply chains. For example, refuse collection vehicles (RCVs) have a market of around 2,500 units in the UK and ten times this across the EU.

Despite their relatively small numbers, trucks, buses and coaches are responsible for a quarter of road transport CO2 emissions and 6% of total emissions. As well as customer demand for low emission vehicles, regulations will also drive a shift, and eventually to achieve Net Zero it is expected that most if not all this fleet of vehicles will be zero emissions. In the shorter-term new EU-level targets set a requirement for a fleet-wide average 15% emission reduction by 2030. This is supported by an incentive mechanism to encourage manufacture of low and zero-emission vehicles.

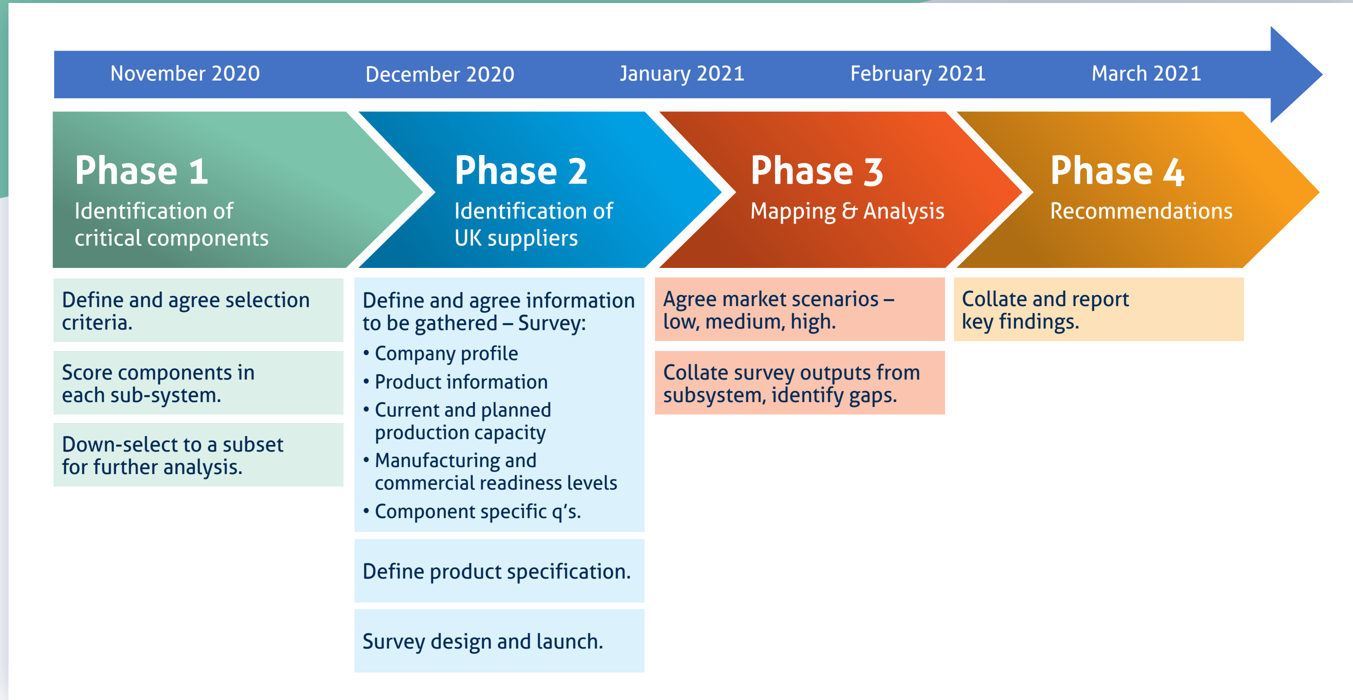
With these incentives in place and increasing pressures to improve air quality, the market for zero-emission heavy-duty vehicles is expected to grow rapidly. The two leading candidate technologies are battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV), but the expected split in the technologies is subject to significant uncertainty with a tendency for FCEV to be more appropriate to heavier, longer range vehicles. A study by Roland Berger for the FCHJU forecasts that FCEV market share could be 15% of the total EU HDV market by 2030 or 60,000 vehicles per year.

However, one of the insights from this study is that, while vehicle weight will play a role, factors such as duty cycle, asset utilisation and time available for "refuelling" will be highly influential on technology choice. Some heavy duty vehicle cycles including articulated trucks are appropriate to BEV, but some lighter vehicles, for example ambulances, have such demanding use cases that FCEV will likely dominate. The study also makes a more conservative forecast of FCEV adoption in the range of 20,000 to 30,000 vehicles per year across Europe by2030.

Methodology

The supply chain identification and capability assessment part of the project was structured into four key phases. The first phase involved the identification of critical or high-value components within the FCEV powertrain for heavy-duty applications using Arcola Energy's technology platform as a baseline. The output of the first phase was a scoring matrix with a list of down-selected critical components and specifications against each, outlining current and upcoming technology requirements. The second phase covered the design and development of the survey questionnaire to gather key information on UK industrial actors with relevant capabilities against the identified components. Phases three and four involved the analysis of the gathered data complemented by additional desktop-based research and gap analysis following by the reporting and collation of the results.

The FCEV powertrain was divided into six key sub systems aligning with APC roadmap categories– Fuel cell, Hydrogen storage, Battery, PEMD (Power Electronics, Motors and Drives), Thermal management, HVAC and Auxiliaries and Control systems and digital services.



Critical Component Identification

For each sub-system, a list of pre-filtered components was supplied by Arcola Energy. The components were then assessed against four key characteristics - performance, cost, technical development and supply chain constraint. The scoring process was informed by literature, the team's collective knowledge and external experts (WMG and DER) as needed. A score of one or zero was given against each criterion such that any components scoring above three were deemed critical.

Cost of a component as a share of the overall powertrain costs, along with opportunities for cost reduction, was an important factor in their competitiveness in the selection process. Performance of each component was assessed by analysing its impact on the overall system.

The supplier base was assessed according to the strength of the supply chain in the UK.

By assessing the H2 supply chain opportunity by application (HDVs), it has allowed the identification of businesses, and their current state of operations, who could deliver a specificcomponent.

Supply Chain Survey Design

An online survey was publicised widely through the NCC, HVMC, Arcola Energy and APC marketing channels to allow supply chain actors to provide their own information. Over 68 completed responses to the questionnaire were received from individual businesses. While this is a good response rate given the short period over which the survey was conducted, it is by no means a complete representation of the H2 supply chain landscape in the UK. In addition to the survey responses, input from recognised organisations such as APC, DER and WMG were used to fill any gaps and sense-check all entries. The complete database has 175 supply chain actors.

The number and type of businesses gave an initial indication of approximate areas of strength and weaknesses. By assessing the H2 supply chain opportunity by application (HDVs), it has allowed the identification of businesses, and their current state of operations, who could deliver a specific component. Furthermore, where an industrial actor's current state of operations did not meet the technology requirements as specified in the survey, responders were encouraged to highlight the key barriers.

Supply Chain Capability Assessment

High Power Batteries

In a fuel cell electric powertrain, the battery provides power delivery and regenerative braking acceptance, so power density for both charge and discharge is critical. The battery is carefully managed within the system, operating between 40% to 80% State-of-Charge (SoC) in micro-cycling mode so deep discharge cycles are rare.

Battery lifetime in this high-power, heavy-duty application is critical. Buses do 5,000 hours per year and operate for at least 15 years, so 75,000 hours is expected. Safety in this heavy-duty environment is essential of course, and good thermal stability characteristics are valuable. Compliance with appropriate standards (Reg 10 and Reg 100.02) is essential.

Gravimetric power density	500 kW/kg for peak power (10s) charge/discharge
Volumetric power density	750 kW/l
Gravimetric energy density	60 kWh/kg
Lifetime	75,000+ hours in micro-cycling mode for road vehicles
Cost	$150/kW (peak)

"The heavy-duty vehicle sector is a critical area that requires decarbonisation but is still in the early stages of development and deployment"

Richard Kemp-Harper
Arcola Energy

Key Insights:

- 15 with the potential (assessed on scale and capability) to supply high-power batteries thiscorresponds to 75% of responses
- 27% of these businesses have a turnover of >£50m and 20% less than £2m
- On average share of turnover related to FCEV ranges from less than 5% to 50%
- Of the 15 only 2 can meet some/all the technical requirements outlined above, with gravimetric energy density being meet now and the potential to meet/exceed gravimetric power density and cost requirement in the future.

  With the exception of the cost target, both manufactures can meet remaining targets however, not in same pack, designed for either energy or power requirements
- Current production output on average ranges from 2MWh to 250 MWh future ambitions on target production output ranges from 15 MWh to over 1.2 GWh
- Main barriers cited for MRL progression; infrastructure, investment and a viable end user
- Expected FCEV:BEV perceived to be in favour of BEVs due to lack of infrastructure and domestic market. Only 10% of responders perceive FCEVs to be a promising opportunity area with some exploring markets outside of the UK, such as South East Asia

Fuel Cell

A key requirement of fuel cells for heavy-duty vehicles is lifetime in operating hours. As examples, a bus will do 5,000 hours per year and have a lifetime of 15 years and a refuse collection vehicle 3,000-4,000 hours a year and a 10-year life. This can be achieved through a combination of design for long lifetime, operating mode and replacement or refurbishment aiming to minimise total cost of ownership. For road vehicles power requirements are in the range of 50kW-250kW.

The critical components identified in the fuel cell sub-system consisted of the complete fuel cell module, oil free compressor and the fuel cell stack.

Key Insights:

- 35 responses of this 66% (23) are potential component suppliers, the rest providematerials
- Of the 23, 17% (4) have a turnover of >£50m, 13% (3) less than £2m, 8% £2m-£10m
- 13% with FCEV accounting for over 50% of annual turnover
- Current TRL levels of products suitable for heavy-duty applications range from 2 to 7, while MRL levels range from 1 to 7, indicating the lack of production ready solutions

  Limited suppliers who can currently meet FC requirements for HDVs with most targeting 10-20kW, only one manufacturer has explicitly stated 44 tonnes long-range trucks as an opportunity area to pursue
- Current production capacity limited with small-scale assemblies and only two reporting production capacity of 150MWh with ambitions to increase future capacity to over 1.2GWh
- Main development barriers sighted include certification and understanding of output requirements to tailor process

  Key MRL barriers include process development for larger batch sizes, validation and end-of-line inspection
- Strong agreement there is considerable supply chain opportunity with strong players and innovative new entrants in the UK. Recognised the size of the opportunity is greater if expanded beyond heavy-duty vehicles and to a wider power range

Hydrogen Storage

The requirement is to maximise hydrogen storage while minimising tank weight, volume and cost. For Arcola Energy's powertrain platform, and for heavy-duty FCEVs in general, the current standard for is 350 bar tanks, either Type 3 or Type 4. To maximise hydrogen storage these tanks are generally large: 2-3m in length and with an external diameter of at least 400mm. In the longer term, technology improvements may allow use of 500bar and 700bar tanks for heavy-duty vehicles, and liquid or cryo-compressed hydrogen storage are also future possibilities.

Gravimetric power density	8.0wt%
Volumetric capacity	0.017 kgH2/L
Cycle Life	5000 fill cycles (~15 years for daily refuelling)
Certification Standards	EC79:2009 or GTR No.13
Cost	£1000/kg H2

Key Insights:

- 31 responses of this 10% (3) in Hydrogen generation and 90% in Hydrogen storage, of the 90%, 30% (7) currently supply either Type III or IV cylinders, 61% (14) supply materials, pipework, tank accessories and/or design and test services, with 22% (5) reporting no capability at present but with ambitions to move into this space and 4% with existing capability which can be adapted
- 25% (7) have a turnover of >£50m, 11% £10m-£50m, 21% (6) £2m-£10m, 43% less than£2m
- For majority of the manufacturers 71%, current share of turnover related FCEV is less than 5%, for the rest this ranges from 5% to under 50%
- 14% currently have capabilities to supply 350bar small and large format pressure vessels suitable for HDVs. 20% either have or are developing capabilities around 700bar small format pressure vessels for passenger vehicles

  TRLs reported range from 1-10, with 14% at 10, 17% TRL 1-3
  MRLs reported range from 0-10, with similar spread to TRL levels
- Production capacity limited, with larger manufacturers reporting units in the hundreds annually with many sighting market developments and demand a key determining factor in scaling production
- Main development barriers to meet requirements for HDVs include UK R&D partners for collaboration, access to funding for prototype development and scale-up, access to local high-pressure proof-test facilities, certification, OEM collaboration and endorsement, NDT and quality assurance requirements
- FCEVs to outweigh BEVs in the heavy-duty vehicle sector, uptake will be accelerated through the introduction of green hydrogen. Across the groups surveyed there is strong agreement that there is significant opportunity for potential co-investment in the UK, i.e. in partnership with local councils. However, this is currently constrained by refuelling network, limited H2 generating capacity and fragmented market with no UK-based supply of composite pressure vessels in volume

Power Electronics, Motors and Drives

Fuel cell electric powertrains have some specific requirements and also a number of common elements with other electrified heavy-duty vehicles. There are opportunities in each of these areas and also in the integration of components to reduce part count and improve efficiency. The critical components identified include Fuel Cell DC-DC, Electric drive and Aux power supply HV to LV.

Fuel Cell DC-DC	Electric Drive	Power distribution and integration
Voltage drop 400V – 300V	Torque: 3000-4000Nm at 0 RPM	High voltage distribution components
Operating output >650V	Power output > 250 kW	High to low voltage (24V) conversion
Power 50kW – 200kW	Driver output equivalent to continuous engine speeds @ 2500-3000 RPM	Inverter integration with motors and drives
Average efficiency > 90%	Motor inverters at 650V DC input and to match motor power requirements	Integration of fuel cell DC-DC, power distribution and inverters

Key Insights:

48 UK-based businesses identified, of this 85% (41) are potential component suppliers, rest provide specialist materials and equipment

of the component suppliers, 65% (31) provide power electronic components and 21% (10) provide motor assemblies

Majority have turnover of less £10m, this may indicate a fragmented market with lots of small to medium size businesses operating in this space

On average share of current revenue related to FCEV technology ranges from 25% to 50% of total reported annual revenue

CCurrent capabilities reported include traction motors, integrated power electronics with nearly all responders noting some capability around high to voltage conversion but requiring further development

Current TRL levels of products suitable for heavy-duty applications are high ranging from 7-10 and MRL levels reporting a wider range from 4-10 indicating existence of production-ready solutions in the local market

Current production capacity limited with small to medium scale

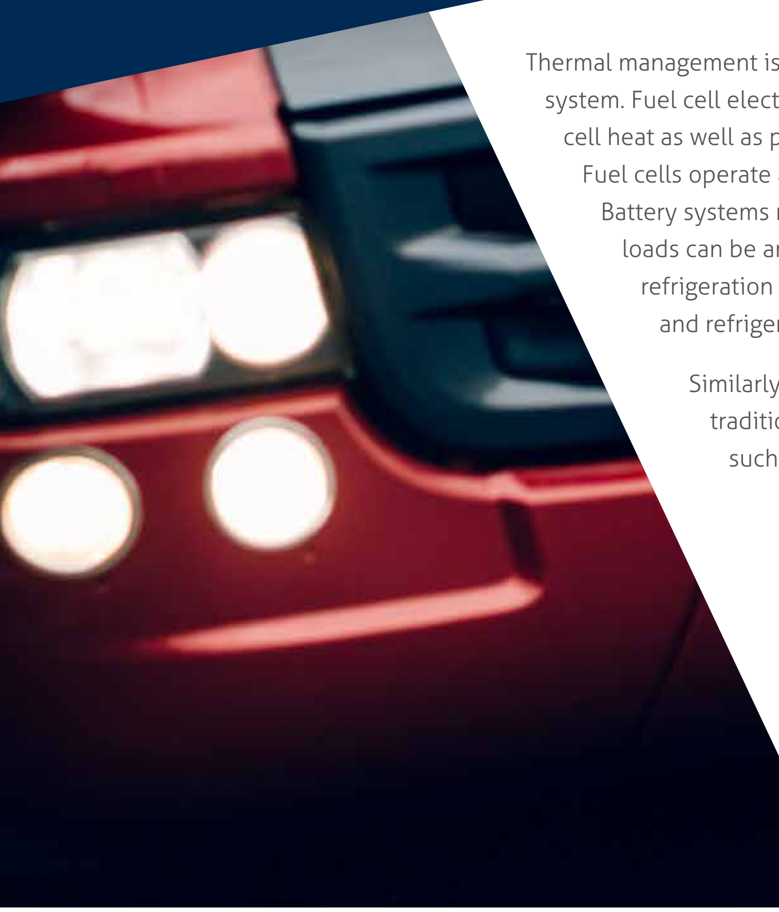
Key barrier sighted to progressing TRL include access to end user and use case as well as on-road certification testing and validation

Key MRL barriers include sufficient demand to enable investment in UK production base, investment and customers partnerships

Perceived opportunity areas in HDVs range from supply of motor laminations, PCBs to partnership development with end user

Expected FCEV:BEV ratio is high in favour of FCEVs within this group of suppliers with scores ranging from 60%:40% through to 80%:20% for FCEVs

FCEV is considered an opportunity area over the coming years, however, it is recognised that supply chain options are limited



Thermal Management, HVAC and Auxiliaries

Thermal management is an important challenge in any electrified vehicle system. Fuel cell electric powertrains have requirements for rejecting fuel cell heat as well as power electronics and battery thermal management. Fuel cells operate at 70C and are around 50% electrically efficient. Battery systems require maintenance at around 25C and peak thermal loads can be around 10kW. Key applications of FCEVs also include refrigeration and buses with air conditioning so electrified HVAC and refrigeration units are of interest from 5 to 30kW of cooling.

Similarly, electrification of auxiliary systems that are traditionally hydraulic or compressed air-driven is of interest, such as power steering or hydraulic body systems.

Key Insights:

- 14 responses received, 86% are component suppliers and 14% provide materials
- Of the component suppliers, majority have an annual turnover of £2m-£10m
- On average share of current revenue related to FCEV technology ranges from 5% to over 50% of total reported annual revenue
- Existing capability around fuel cell and powertrain thermal management systems, with electrified HVAC systems, electrified refrigeration and battery thermal management requiring further development

  Current TRL levels of products suitable for heavy-duty applications range from two 4 to 10, while MRL levels range from 3 to 7, indicating the lack of production ready solutions
- Current production capacity limited and varies depending on product
- Main R&D requirements to progress TRL consist of adapting existing technologies proven in other sectors for HDVs, validation on powertrain and mule test vehicles, de-risking progression from sub-assemblies to full scale system testing and material scale-up

  Some common barriers to progress MRL for HDV applications sighted include scaling existing production processes, capital investment for repurposed facility and successful vehicle trials to encourage further scale-up
- Perceived opportunities in the HDV sector cover advanced heat shielding solutions, improved thermal management for batteries and thermal barrier coating solutions

  suppliers surveyed in this area are agnostic to battery vs fuel cell technology, many have positioned themselves to cater for both and have prioritised understanding the technology requirements with existing pipeline and R&D activities covering both areas

  Views on UK supply chain opportunities for this segment vary, while the opportunity is recognised and a supply chain exists barriers sighted include effective partnerships between SMEs and OEMs to bring innovative technologies to market, smaller total market potential than other sectors and heavily hit by COVID-19, lacking strong engagement to rapidly progress R&D, investment required to increase capacity

Control Systems, Data and Digital Services

Electrified powertrains offer new opportunities in control and improved vehicle lifetime management through data capture and analysis. FCEV powertrains have particular requirements but approaches and technologies applied in other areas may well be relevant. Potential areas of interest include the following:

- **Hardware and software to support functional safety and vehicle integration**
- **Hydrogen sensors**
- **Predictive energy management**
- **Remote monitoring, diagnostics and predictive maintenance**

Key Insights:

- 21 suppliers identified, of which 71% (15) provide control systems and/or data management software and/or hardware and 29% supply sensors
- Majority of the suppliers in this segment have an annual turnover of £2m-£10m and are technology developers and integrators with limited manufacturing capabilities in the UK
- Significant portion current share of revenue come from oil and gas with suppliers looking to diversify into non-fossil fuel-based markets
- Existing capability covers control and systems integration and functional safety, with predictive control and energy management commonly sighted as areas requiring furtherdevelopment

  TRL levels of products suitable for HDV applications range from 3 to 9 with no MRL levelsreported
- Current production capacity limited and varies depending on product
- Main barriers to progress technology include access to good vehicle models and CAN specific data for onward transmission
- FCEVs viewed as a better long-term technology, however, rate of adoption constrained by industry familiarity and experience and infrastructure

  UK supply chain opportunities are emerging but difficult to quantify, absence of production facilities to deliver adequate battery technology at scale and unpredictable customer demand seen as key limiting factors

Conclusions & Recommendations

Overall, this study confirms that, while there is little current UK supply of components that meet benchmark requirements for FCEV heavy-duty powertrains, there is nevertheless significant UK capability that could meet these requirements and benefit from this emerging market. The study shows this to be particularly true in hydrogen storage and PEMD but with potential across all technology areas.

Hydrogen storage received the strongest response in the survey. At present, there is some existing capability to manufacture small and large format 350 bar cylinders in the UK and strong interest in developing products for this and other markets, however local production is limited to small batches. Market development and demand are seen as key determining factors in scaling production.

Although the PEMD survey received the fewest responses, this data was augmented with input from the APC and DER centres. Within PEMDs, the majority of the businesses identified, reported an annual turnover of less than £10m, indicating a fragmented market with mainly small to medium size businesses operating in this space, but with opportunities to grow. Current capabilities included traction motors and integrated power electronics with nearly all respondents noting a need for further capability development on high to low voltage conversion. The suppliers in this segment also reported the highest TRL and MRL levels across the entire powertrain. This may indicate the existence of production-ready solutions in other market segments that could be adapted for heavy-duty vehicles.

In batteries, two suppliers were identified that meet some of the technical requirements outlined for HDV applications. Most could meet the gravimetric energy density requirement, while further development was needed to meet the power density requirements and cost. This would indicate that there is some relevant capability in batteries but that dedicated R&D is needed to meet the FCEHDV powertrain requirement.

Within responses to the fuel cells survey, the TRL levels of suitable products ranged from 2 to 7 and MRL levels ranged from 1 to 7, indicating a lack of production-ready solutions today. For thermal management and HVAC, current production capacity in the UK was limited and varied depending on product. It was generally recognised among responses received for thermal management, that adapting existing technologies proven in other sectors would be the first step in progressing the development of HDV-ready solutions.

Perceptions on the UK supply chain opportunity within FCEVs also varied across the different supplier groups with battery suppliers, perhaps unsurprisingly, tending to favour BEVs. However, overall, there was broad agreement that FCEVs are the better technology for the long-term, while recognising that the rate of adoption will be constrained by industry familiarity, experience and infrastructure. For most, the UK supply chain opportunities are only beginning to emerge, and they remain difficult to quantify with uncertainty on market development, customer demand and H2 generationcapacity.

The most commonly cited development barriers to meet HDV requirements across all sub-systems in the order of frequency of appearance consisted of:

- **Lack of effective partnerships and collaboration between suppliers and end users**
- **Access to investment and funding for prototype development and scale-up**
- **On-road certification testing and validation**
- **Access to vehicle models**
- **Access to NDT and quality assurance requirements**
- **Access to local high-pressure proof test facilities (hydrogen storage)**

These barriers identified by survey respondents lead to the key recommendations below for interventions to enable the UK to make the most of the emerging opportunity in this technology and market segment.

Key Recommendations

Supply Chain Integrated DeploymentProgramme

Urgency to act has been created by significant investment and intervention in other manufacturing nations. The UK must react to this signal if it's not to miss out on capturing significant value from FCEV uptake. It is proposed that we should responded to this stimulus with a coordinated and integrated national effort to rapidly deploy HDFCEV vehicles, in a manner that captures both immediate learning and maximum long-term value for supply chain actors. The programme should be based on the following fundamental keyprinciples.

- **At-Scale Deployment** – deployment a of significant number of semi-standardised vehicles that have been integrated in the UK, by organisations such as Arcola, using best-in-class technology. These vehicles can and will evolve to be used as living test beds to validate UK-developed technology with minimum risk to theintegrators
- **Supply Chain Integration & Learning** – potential supply chain actors will play a key part in the programme, with open access to the vehicle integrators they will gain knowledge of market gaps, performance requirements and reliability and operational challenges
- **Market Development** – at-scale deployment will create real demand and stimulate the market for FCEV and BEV common components
- **Import Substitution** – as domestic technology matures and exceed best-in-class it can be used to replace imported components
- **Funding** – the programme will identify how and where support can be aligned to application-driven fundamental research through to manufacturing scale-up of products that displace importedtechnology
- **Networking & Standardisation** – bring together supply and demand and drive standardisation of vehicle requirements and selection across local and regional initiatives to enable integrators and supply chain actors to benefit from economies of scale and product competitiveness

> *"Urgency to act has been created by significant investment and intervention in other manufacturing nations. The UK must react to this signal if it's not to miss out on capturing significant value from FCEV uptake."*

Comprehensive Testing and CertificationCapabilities

In addition to the above supply chain integrated deployment programme, comprehensive testing facilities at both component and system level should be created to enable cost-effective pre-vehicle testing. This critical resource may be a 'single front door' to existing distributed capabilities or a specific capability, but its sole purpose would be to accelerate route to market through advanced virtual and physical testing andcertification.

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About the Advanced Propulsion Centre

The Advanced Propulsion Centre (APC) collaborates with UK government, the automotive industry and academia to accelerate the industrialisation of technologies, supporting the transition to deliver net-zero emissionvehicles.

Since its foundation in 2013, APC has funded 150 low-carbon projects involving 375 partners, working with companies of all sizes, and has helped to create or safeguard over 50,000 jobs in the UK. The technologies developed in these projects are projected to save over 260 million tonnes of CO2, the equivalent of removing the lifetime emissions from 10.2 million cars.

In 2019 the UK government committed the Automotive Transformation Fund (ATF) to accelerate the development of a net-zero vehicle supply chain, enabling UK-based manufacturers to serve global markets. ATF investments are awarded through the APC to support strategically important UK capital and R&D investments that will enable companies involved in batteries, motors and drives, power electronics, fuel cells, recycling, and associated supply chains to anchor their future.

For more information go to apcuk.co.uk or follow us @theapcuk on Twitter and Advanced Propulsion Centre UK on LinkedIn.

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