

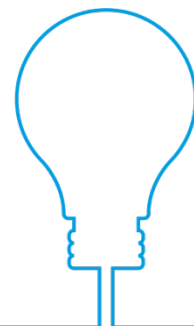


Department for
Business, Energy
& Industrial Strategy

SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Components Development Competition (Hy4Heat Work Package 5b)

(An SBRI Competition: TRN: 1996/07/2019)

Invitation to Tender



2 August 2019

**SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component
Development Competition (TRN: 1996/07/2019)**

Date: 2 August 2019

As part of the Hy4Heat Programme, the Department for Business, Energy & Industrial Strategy ("BEIS") wishes to appoint contractors to develop one or more of the following products:

- Safety certified commercial hydrogen appliances (core requirement of ITT)
- Fully certified commercial hydrogen appliances (core+ requirement)
- Boiler cascade systems
- Components for the safe installation of hydrogen appliances

All proposals will demonstrate the developed products ability to be run on hydrogen under a pre-commercial procurement competition.

Enclosed are the following sections (described in detail under Contents):

- Sections 1 to 10
- Annexes 1 to 8

See also the following separate documents:

- Contract Terms and Conditions
- Pricing Schedule

Please register your interest in submitting a tender for this project at the following email addresses: builtenvironmentinnovation@beis.gov.uk and Hy4Heat@arup.com

Your email must include the following subject line:

- 'Registration of Interest: SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Components Development Competition'

All notifications of updates to the Invitation to Tender (ITT) process or answers to questions raised by potential bidders will be issued by email, so it is important that you have registered your interest to receive them.

Please read the instructions on the tendering procedures carefully since failure to comply with them may invalidate your tender.

Your tender must be received by **12 noon on Friday 13 September 2019**, by email at the following email address, builtenvironmentinnovation@beis.gov.uk.

Your email must include the following subject line:

- 'TENDER: SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Components Development Competition'
- Further instructions are included in Section 4.

I look forward to receiving your response.

Yours sincerely,

Steve Loades, BEIS Programme Manager – Hy4Heat

Email: builtenvironmentinnovation@beis.gov.uk

PRIVACY NOTICE

Identity and contact details of the Data Controller (and where applicable, the controller's representative) and the Data Protection Officer.

The Data Controller is the Department for Business, Energy & Industrial Strategy (BEIS). You can contact the BEIS Data Protection Officer at: BEIS Data Protection Officer, Department for Business, Energy and Industrial Strategy, 1 Victoria Street, London SW1H 0ET. **Email:** dataprotection@beis.gov.uk.

Purpose of the processing and the legal basis for the processing

Any personal data contained within submitted tenders will be processed by BEIS or on behalf of BEIS for the purposes of the tender exercise described within the remainder of this Invitation to Tender, or in the event of legal challenge under The Public Contract Regulations 2015 or The Limitation Act 1980.

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You have the right to lodge a complaint with the Information Commissioner's Office (supervisory authority) at any time. Should you wish to exercise that right full details are available at: <https://ico.org.uk/for-organisations/guide-to-the-general-data-protection-regulation-gdpr/individual-rights/>.

The existence of automated decision making, including profiling and information about how decisions are made, the significance and the consequences.

The provision of the information you provide is not connected with individual decision making (making a decision solely by automated means without any human involvement) or profiling (automated processing of personal data to evaluate certain things about an individual)

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1. Introduction

This Invitation to Tender (ITT) document sets out the context, scope, application process and assessment criteria for the SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Components Development Competition (Hy4Heat - Work Package 5b).

This Competition focuses on the development of commercial hydrogen appliances, boiler systems and ancillary system components necessary to demonstrate the safe use of hydrogen as a fuel in providing commercial heating, hot water, and cooking requirements. It aims to prove the feasibility of these appliances through critical evidence of end use application, safety, in-use emissions, and functionality.

The key concept is that any new hydrogen appliance shall essentially be a variant on an existing and widely sold Natural Gas (NG) appliance. This base natural gas product shall be called the 'reference product', and the hydrogen version should ideally be of similar size, efficiency, emissions (except CO₂), aesthetics and comfort. It is appreciated that due to the combustion characteristics of hydrogen this may not be fully achievable, but the essence is a 'like for like'¹ replacement. Manufacturers may also propose an appliance that could meet a future market need for commercial hydrogen appliances, where there may not be a reference product (e.g. an innovative appliance utilising a fuel cell) whilst ensuring the proposal meets the functional applications as set out in this ITT. It is expected that proposals will target projects which will maximise technical benefit in demonstrating the use of hydrogen in the commercial sector. This would likely include appliance types that are common in the market as well as those for which hydrogen replacements are more technically challenging to develop. Through this development, it is hoped that the supplier maximises the amount of lessons learnt as well as de-risking the use of hydrogen for heat in buildings. Suppliers should clearly evidence the market need for their proposals as part of their bid.

The essential requirement for appliances developed within this competition is to demonstrate that safe, efficient, and low Nitrogen Oxide (NO_x) commercial hydrogen appliances can be created as a 'like for like' alternative to existing methane appliances. A UK transition to hydrogen would present a huge logistical challenge and products that simplify the switch-over process (e.g. 'dual fuel', 'hydrogen ready' or 'adaptable'²) would be highly desirable. Tenderers are encouraged to include 'dual fuel', 'hydrogen ready' or 'adaptable' appliances that can be developed alongside all essential deliverables detailed in Section 7, within the competition timeframe and in line with the example funding.

¹ 'Like for like' is defined as having a reference appliance that uses natural gas as a fuel.

² 'Dual-fuel' refers to the ability to interchange between gas types without the need to change over components; 'Hydrogen ready' refers to appliances that are optimally designed to run on hydrogen but initially configured to run on natural gas. These appliances then may require a minimum number of components to be changed at the point of switchover but will have been specifically developed to facilitate this process; 'adaptable' refers to the replacement of a minimum numbers of key components within existing natural gas appliances to allow them to run on hydrogen. Definitions adapted from BEIS commissioned report 'Appraisal of Domestic Hydrogen Appliances', Frazer-Nash Consultancy, February 2018

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The total potential value of the Competition is up to £4.9m (ex VAT) although BEIS may allocate less than this depending on the quality of the applications received. The competition is split into lots defined by functionality to meet different requirements of the Hy4Heat remit in the commercial sector:

- Lot 1: Catering & Production Heating
- Lot 2: Dry Space Heating
- Lot 3: Wet Space Heating
- Lot 4: Combined Heat and Power
- Lot 5: Ancillary System Components

This Small Business Research Initiative (SBRI) competition will run until March 2021, and is aiming to deliver:

- Prototype Appliances that demonstrate the feasibility of commercial hydrogen appliance development. Prototypes may either be:
 - Safety certified, referred to as the core requirement of this ITT. or;
 - Fully certified and have demonstrated the safety certified appliances for a minimum of 2 months. This could be within WP8 unoccupied demonstration trials. Referred to as the core+ requirement of this ITT.
- Boiler Systems: Development of control systems for cascades of hydrogen boilers.
- Ancillary System Components: A set of components demonstrating safe installation of hydrogen appliances in buildings.

Bids will be submitted into sub-lots and assessed against the relevant evaluation criteria. The table below gives example funding for each lot. For the development of appliances, the funds below are guidelines for the core requirement of this ITT (safety certified products). Suppliers delivering fully certified appliances may need to price up to 20% more, however this figure may vary.

Lot	Sub-lot	Example funds per contract (excl. VAT)
LOT 1 Catering & Production Heating	LOT 1A ≤15 kW	£100, 000
	LOT 1B 15 – 30 kW	£200,000
	LOT 1C ≥30 kW	£300,000
LOT 2 Dry Space Heating	LOT 2A ≤50 kW	£100,000
	LOT 2B 50 – 120 kW	£200,000
LOT 3 Wet Space Heating	LOT 3A Burner integrated with a shell boiler (>400 kW)	£200,000
	LOT 3B Control for a boiler cascade (<400 kW)	£150,000
LOT 4 Combined Heat & Power		£250,000
LOT 5 Ancillary System Components		£70,000

**SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component
Development Competition (TRN: 1996/07/2019)**

It is anticipated that between one and three projects per sub-lot will be selected. The number of projects funded will be dependent on the quality of applications and funding available within the value of the competition. Please refer to Section 3 – Competition Process for further information of allocation of funding.

Note: All applications must be received electronically by BEIS by 12 noon on 13 September 2019, at the following email address:

builtenvironmentinnovation@beis.gov.uk

See Section 4: Application Process of this document for details of how to apply.

1.1 Context

Background

Heating is essential to our lives – it is the biggest reason we consume energy in our society and is responsible for over a third of our emissions. Meeting our 2050 net-zero target means that heat in buildings will need to be almost completely decarbonised and heat in industry will need to be reduced close to zero emissions.

There is no clear consensus on the best approach to decarbonising heat at scale. However, there are a number of options with potential to play an important role. One of these is to utilise low carbon gases such as hydrogen. Over 80% of homes and business are currently supplied by gas and the UK has one of the most comprehensive gas networks in the world with 282,000km of gas pipes feeding 22.7 million buildings.

In December 2018 the Department for Business, Energy and Industrial Strategy (BEIS) published Clean Growth: Transforming Heating which provides an overview of the key issues arising from a review of the evidence base on approaches to achieve heat decarbonisation. It sets out where BEIS believe efforts should be focused across industry, academia and the public sector over the next 2-5 years to inform development of a long-term policy framework. The Government is leading a number of innovation and practical demonstration projects to help address some of the key uncertainties.

The hydrogen approach

To be able to inform any future assessment of the feasibility of the costs and benefits of undertaking a hydrogen conversion, a full understanding of issues from end-to-end (production to use) of the gas chain will be required.

The hydrogen gas chain can be split into the following stages:

- Production (including plant and CO₂ off-take, CO₂ sequestration and hydrogen storage).
- Transmission network (involving the pipework that transports the gas under a pressure of between 7 and 85 bar).
- Distribution network down to the end user's gas meter (involving pipework that transports the gas under a pressure of up to 7 bar).
- End-use (i.e. downstream of the Emergency Control Valve (ECV)).

The innovation programme, Hy4Heat, seeks to prove the safety case for the use of hydrogen for heating in GB homes and businesses, downstream of the Emergency Control Valve.

Hy4Heat Programme

The Department for Business, Energy and Industrial Strategy (BEIS) has appointed Arup+, a group of companies led by Arup, as the Programme Management Contractor (PMC) to manage and successfully deliver Hy4Heat, a programme to demonstrate and prove the safety case for the use of hydrogen for heating in GB homes and businesses.

The Hy4Heat programme's aim is:

- To establish if it is technically possible and safe to replace methane with hydrogen in commercial and residential buildings and gas appliances. This will enable the Government to determine whether to proceed to a community trial.

The Hy4Heat programme's overall objective is:

- To provide the technical, performance, usability and safety evidence to de-risk the use of hydrogen for heat in buildings whilst working with others to prepare for a potential future occupied trial.

The programme's focus is on researching, developing, testing and demonstrating within the end-use stage of the gas supply chain. This will involve the gas appliance and equipment sectors as well as consumer research.

The programme is aiming to demonstrate:

- That safe, reliable, efficient and affordable end-use appliances and equipment can be developed for the lower pressure, below seven bar domestic and commercial sectors.
- That hydrogen can be safely distributed to the end user appliances in existing buildings' pipework, downstream of the ECV.
- Initial findings of what the consumer experience of a hydrogen fuelled home will be. This includes demonstrating through unoccupied trials appliance suitability, as well as developing requirements and options for progressing to a potential community trial.

The Hy4Heat programme will be completed by the end of March 2021. It is envisaged that it will consist of ten Work Packages:

- Programme management
- Definition of a hydrogen quality standard
- Establishing an appliance and equipment testing capability
- Development of domestic hydrogen appliances
- Commercial appliances
 - a. Understanding commercial appliances
 - b. **Development of commercial hydrogen appliances, boiler cascade, and ancillary components (this Invitation to Tender (ITT))**
- Understanding industrial appliances
- Assessment of suitability of hydrogen in existing buildings
- Hydrogen demonstration trials in unoccupied building
- Preparations for a potential occupied consumer community trial
- Development of smart hydrogen meters

Arup+, as the PMC, are responsible for delivering Work Packages 1 and 9 as part of their contract. Arup+ will manage the delivery of Work Packages 2 – 8 and 10 and, as part of the conditions for the PMC role, have agreed not to bid for the remaining Work Packages that will be delivered by other suppliers.

This ITT directly supports the delivery of Work Package 5b, Development of commercial hydrogen appliances, boiler cascade, and ancillary system components.

1.2 Small Business Research Initiative

The Small Business Research Initiative (SBRI) pre-commercial procurement (PCP) is a quick, simple and well-established process that enables the development of innovative products and services in response to specific challenges faced by Government departments and public sector bodies. Successful business partners receive finance to develop their innovative ideas, generating new business opportunities and routes to market. PCPs have been successfully run in the UK through Innovate UK and the SBRI.

This procurement approach has been undertaken within work package 4 of the Hy4Heat Programme – development of domestic hydrogen appliances. There are currently 14 successful projects underway within this work package.

1.3 The Challenge

The aim of the Competition is to develop ‘like for like’³, functional, appliances, boiler cascade, and ancillary system components which can demonstrate the safe use of hydrogen as a fuel to meet commercial catering and heating requirements.

Objectives

The objectives of the Competition are to:

- Deliver prototype appliances or ancillary components which can demonstrate safe use of hydrogen as a fuel in providing commercial catering and space heating requirements;
- Understand, and where feasible address, the challenges and risks associated with progressing the appliances or components to a volume manufacturing stage;
- Understand the challenges and potential solutions for a transition to hydrogen, including products that simplify the switch-over process (e.g. ‘dual fuel’, ‘hydrogen ready’ or ‘adaptable’ - see Annex 1);
- Target prototype development on appliances, boiler systems and ancillary system components which will maximise technical benefit in demonstrating the use of hydrogen in the commercial sector;
- If possible, depending on the development time required, demonstrate the use of the prototype appliances in unoccupied demonstrations (Hy4Heat work package 8).

Geographic scope

The competition is open to all organisations within the European Economic Area (EEA). Unoccupied trials and testing must be done in Great Britain.

³ ‘Like for like’ is defined as having a reference appliance that uses natural gas as a fuel.

1.4 Structure of the Competition

The Competition will be overseen by the BEIS Hy4Heat Programme Board, supported by a BEIS/Hy4Heat team that will manage and monitor the competition.

For appliance development:

The Competition will include several milestones which require developing a detailed design document, followed by the development of a first safety certified prototype suitable for unoccupied demonstration trials and with supporting business plans for consideration of any potential future scale up. The core requirement of this ITT is delivery of a safety certified prototype by March 2021. However, support will be available to suppliers who are able to develop a fully certified prototype in the given timeframe (i.e. before March 2021) as well as demonstration for the safety certified prototype in unoccupied demonstration trials.

For boiler cascade development:

The Competition will include several milestones which require development of control systems for cascades of hydrogen boilers and demonstration of the boiler cascade before December 2020.

For ancillary system components development:

The Competition will include several milestones which require the assembly of a set of components demonstrating safe installation of hydrogen appliances in buildings. This will include obtaining individual components from relevant Original Equipment Manufacturers (OEMs) and working with the OEM to ensure that the component is approved for use with hydrogen.

There will be a maximum of two to three projects funded across each of the sub-lots⁴. BEIS reserves the right to take a portfolio approach when awarding funding to projects to ensure that the competition supports a range of appliances and ancillary system components across the heating sector. Within these lots, BEIS may therefore choose to allocate the budget to lower scoring projects to develop a range of appliance types which most contributes to the overall objective to provide the technical, performance, usability and safety evidence to de-risk the use of hydrogen for heat in buildings. For a specific sub-lot, if tenders received are only for 'hydrogen only' appliances with no acceptable tenders received for 'dual fuel', 'hydrogen ready' or 'adaptable' appliances, BEIS further reserves the right to only award part or none of the funding available for that lot.

⁴ Depending on the quality of applications, BEIS may choose to not progress competitions in one or more sub-lots.

1.5 Reading this ITT

Due to the varying nature of the work required to deliver the projects procured in this ITT. Sections of this ITT are split to give the relevant information about the work required for each type of project. Types of work include:

- Appliance development
- Boiler cascade development
- Components development

The sections which are split and therefore it is advised that the supplier reads particularly carefully are:

- Section 2: Activities and Timescales
- Section 7: Deliverables
- Section 8: Evaluation Criteria (specifically technical approach)
- Section 9: Support Available

The remainder of the sections within this ITT are relevant to all contracts.

The table below shows the corresponding type of work for each sub-lot.

Lot	Sub-lot	Type of Work
LOT 1 Catering & Production Heating	LOT 1A ≤15 kW	Appliance Development
	LOT 1B 15 – 30 kW	
	LOT 1C ≥30 kW	
LOT 2 Dry Space Heating	LOT 2A ≤50 kW	
	LOT 2B 50 – 120 kW	
LOT 3 Wet Space Heating	LOT 3A Burner integrated with a shell boiler (>400 kW)	Boiler Cascade Development
	LOT 3B Control for a boiler cascade (<400 kW)	
LOT 4 Combined Heat & Power		Appliance Development
LOT 5 Ancillary System Components		Components Development

2. Activities and Timescales

2.1 Appliance Development - Lots 1, 2, 3A and 4 (November 2019 – March 2021)

Appliances will be developed under Lots 1, 2, 3A and 4. This section gives an overview to the work required for each lot.

Lot 1- Catering & Production Heating

Lot 1 is focused on the provision of catering equipment although bids are sought for any widely selling gas fired product that is non-domestic and not specifically included in Lots 2, 3 and 4 (below).

Lot 2 – Dry Space Heating

It is anticipated that for this programme a range of appliances may include:

- Warm air heating appliances – these are specifically designed to provide space heating by using the heat generated by a burner to raise the air temperature in the space(s) being heated.
- Radiant heating appliances – these are specifically designed to heat people or objects in the space below them by infrared radiation without heating the surrounding air directly.

Lot 3A - Burner integrated with a shell boiler (≥400 kW)

Individual commercial applications can have peak heat demands of up to 1000 kW or more; the approach taken in meeting this demand is vastly different to that of the domestic products under development within Hy4Heat. At this scale Hy4Heat suggests a combination of hydrogen forced draft burner and existing boiler may be the most cost-effective solution. This larger size of boiler house cannot be addressed through a cascade of domestic products as the numbers become impractical. Projects developing the forced draft burner for a larger boiler unit (≥400 kW) will therefore be considered for support. The burner and shell boiler will need to be offered as a fully integrated product.

BEIS reserves the right not to fund development or scale up of any technology, the development of which is already being supported within the Hy4Heat programme, Work Package 4 or other BEIS innovation programmes. Therefore, the development of large boilers using a technology already developed under WP4 would not be considered for this competition.

Lot 4 – Combined Heat and Power (CHP)

Essentially a 'like for like' product is sought except that it must be heat led and optimised for heat production, example products that will be considered for support will include:

- **Fuel cell micro (mCHP):** The fuel cell assembly itself will already be proven in consuming hydrogen. This product could currently be operated in power only mode. The fuel cell could be part of an existing natural gas fired product containing an on-board reformer. Lot 4 will seek the repacking of this fuel cell into a product suitable for commercial applications operating on hydrogen.

- **Stirling engine mCHP:** The Stirling engine will already be well proven in consuming a range of gases. Lot 4 will seek the repackaging of this into a product suitable for commercial applications operating on hydrogen.
- **Internal combustion engine mCHP:** This internal combustion engine will be well proven in consuming a range of gases. Lot 4 will seek the repackaging of this into a product suitable for commercial applications operating on hydrogen.

2.1.1 Solution Design (core requirement)

The first stage of the appliance development is to develop a solution design document. This will detail the concept described in objective 1 (see Section 1.3), which will subsequently be developed, tested and safety certified as part of the project.

This should demonstrate that the new appliance is technically viable and include an understanding of the issues to be overcome and proposed solutions.

There are some key challenges that applicants will need to consider at this stage and make plans for within their designs:

Key challenges

- **Functionality** – Manufacturers should demonstrate how they intend to meet the challenge of producing a functional hydrogen fired device. The appliance must light and operate in a controlled and sustained manner.
- **Safety** – The primary hazards when considering the use of a flammable gas are fires and explosive gas/air mixtures. These usually result from a leak or unexpected event which causes a release of gas that is subsequently ignited. Manufacturers should provide evidence of how their appliance(s) will meet the challenge of reducing the likelihood and scale of such events. In particular, designs should incorporate delayed ignition and flame detection solutions. They should also be able to withstand worst case delayed ignition within the combustion chamber, flue and the appliance case.
- **Fluing and Ventilation** – For hydrogen appliances, condensate is an important consideration as approximately 40% more water is produced (at stoichiometric combustion) per MJ of heat input than for natural gas (methane). Manufacturers must demonstrate how they will overcome the challenge of removing this water vapour to avoid/mitigate the risks to the appliance and building fabric associated with condensation, such as corrosion, damp and mould development.

Deliverables: The output required will be a feasibility report that describes the necessary product development steps and associated outputs necessary for the remainder of the project. Minimum requirements of the report are provided in Section 7.

Timescale: This report is required to be delivered **before 31 January 2020**.

2.1.2 Prototype Development (core requirement)

This stage will focus on the physical development of the first prototypes as detailed in the solution designs. The prototypes are required to be tested for functionality and safety as part of the project, the cost of this testing must be included in the bid value.

A final deliverable will include delivery of a business plan for scaling up the manufacture of appliances and training of installers in preparation for a potential future community trial and subsequent sales. The business plan should also consider potential further product developments to facilitate a long term roll out programme for hydrogen transition as well as cost to the consumer.

Developments should include a full explanation about how the product would deliver a 'dual fuel', 'adaptable' or 'hydrogen ready' capability, including the likely cost, implications on efficiency and time to convert, where appropriate.

Deliverables: Outputs proposed will include a report, which will provide evidence of successful completion of required milestones (Section 7). Outputs of each project will also include:

Appliance test report – covering functional and safety test results and any other test the manufacturer considers necessary to demonstrate the readiness of the appliance.

Five fully packaged examples of the appliance prototype including all paperwork and CE Gas Appliance Regulation (GAR) type test report and demonstration of the prototype being safely installed, operated and maintained.

Details of plans for further product development to obtain full certification, meeting emissions and full aesthetic requirements (not applicable for Core+ submissions).

Timescale: Prototypes and business plans are required to be delivered before March 2021. Within this timescale, delivery dates for the outputs detailed in Section 7 should be provided by the supplier.

The core requirement of this ITT is for safety certified appliances to be delivered by March 2021.

2.1.3 Emissions & Efficiency Certification and Demonstration (only applicable for core+)

In addition to the core requirement for the development of safety certified appliances. Suppliers who are able to demonstrate the safety certified appliances for a minimum of 2 months (between April 2020 and March 2021). These appliances may then be used within the WP8 unoccupied demonstration trials. In addition, suppliers who can deliver fully certified prototypes by March 2021 are encouraged to do so as part of the core+ requirements. Bids capable of delivering safety certified prototypes ahead of March 2021 should clearly evidence the method and timeline by which they aim to achieve this in their tender documents. To achieve this, suppliers will be required to address the following additional challenges within their solution design reports.

Additional Challenges

- **Efficiency** – Manufacturers should demonstrate how they will meet the challenge of achieving appliance efficiency (on the same calorific value basis) that is comparable to that achieved for the reference natural gas product and as specified in the relevant product standard.
- **Emissions** – Manufacturers should demonstrate how they intend to meet the challenge of achieving NOx emission levels that are compliant with (essential) or better than the 2021 Ecodesign limits (e.g. 56mg/kWh for boilers and 130mg/kWh for local space heaters). NOx levels will be primarily determined by the flame condition, which will be determined by the burner design. Balancing flame temperature and excess air requirements will be key to meeting the efficiency and NOx emissions requirements.

Deliverables: In addition to the deliverables given in sections 2.1.1 and 2.1.2, additional outputs of meeting the core+ requirements of this ITT will include:

- Provision of one packaged example of the fully certified appliance. To include user, installation and maintenance instructions as per the requirements of the GAR by March 2021.
- A final project report detailing design and development of the fully certified appliance.
- Results, outputs and / or specifications of prototypes developed including unoccupied demonstration trial results, test results and certificates to demonstrate compliance with the safety and performance standards.

Timescale: All activities must be completed before March 2021. Within this timescale, delivery dates for the outputs detailed in Section 7 should be provided by the supplier.

2.1.4 Final Outputs (core requirement)

Final outputs for all projects will include:

- A final project report detailing design and development of the prototype.
- Prototype test results and certificates to demonstrate compliance with the safety and performance standards⁵.
- Recommendations for further dissemination of knowledge and learning from the project.

2.2 Boiler Cascade - Lot 3B (November 2019 – March 2021)

The fundamental combustion technologies that would be needed for dedicated water heaters are being developed for boilers in WP4. Therefore, the development of dedicated units for production of sanitary hot water is not included in the scope of this ITT.

A cascade of boilers is often used to link and control several units to achieve a higher power output than a single boiler provides. Cascades of natural gas boilers already exist as products and comprise groups of boilers, (generally all of the same rated capacity), with overall controls that determine which of the boilers runs and at what output level. Cascade controls for groups of such boilers would need to accommodate the hydrogen specific firing strategies that they incorporate.

Hydrogen boilers have already been procured under Work Package 4: Domestic Appliances and, therefore, it is not deemed necessary for procurement of further boilers of power output <400 kW in this commercial sector competition. However,

Timescale: Prototypes and business plans are required to be delivered before March 2021. Within this timescale, delivery dates for the outputs detailed in Section 7 should be provided by the supplier.

⁵ Evidence that emissions and full aesthetic requirements have been met is required for fully certified prototypes.

2.3 Components Development - Lot 5 (November 2019 – March 2021)

In order to produce a more complete portfolio of products at the end of the Hy4Heat programme, which fully demonstrates the safe use of hydrogen for heating in commercial and domestic buildings, Hy4Heat is supporting the development of ancillary system components that will be necessary for the safe installation of hydrogen appliances. This ITT seeks to make available the ancillary system components that are used by installers to complete the gas supply chain from the appliance isolation valve, up to and including the ECV.

Such components would include (but are not limited to):

- Piping (including connecting hoses and metal pipe)
- Pipe fittings (for connecting pipes)
- Gas valves
- Gas pressure regulators
- The emergency control valve

The scope of ancillary system components is detailed in Annex 1 and a product specification is provided in Annex 2.

Components demonstrated as suitable for use with hydrogen for installation of domestic and commercial scale appliances are not currently available. Suppliers are encouraged develop hydrogen approved ancillary system components which are comparable on cost, to the natural gas approved components used today.

It is unlikely that individual manufacturers would produce the full range of components needed. It is expected that gas component wholesalers/merchants will be more suitably positioned with regards to overall reach within the gas component supply chain to identify the range of ancillary system components and to engage with suppliers to deliver components demonstrated to be suitable for use with hydrogen. This does not preclude any manufacturer with a sufficiently broad product range from tendering for this project.

As part of their ITT submission, suppliers are requested to review which components from existing catalogues of appliance installation components, will be required for hydrogen appliance installation.

Projects within this lot, are expected to determine whether components currently certified for use with natural gas can be certified for use with hydrogen. This will include review of the technical files, consideration of whether the materials are compatible for use with hydrogen and if necessary, identify and commission any necessary testing.

Suppliers within this lot are expected to be working with various Original Equipment Manufacturers (OEMs) and generally the OEMs will need to go through the process of obtaining the necessary documentation of components. The supplier will be required to coordinate the efforts of the relevant OEMs in order to ensure that evidence will be provided that the components are fit for purpose with hydrogen. It is the supplier's responsibility to demonstrate a complete set of components for the installation of a hydrogen appliance from the appliance isolation valve, up to and including the ECV by March 2021.

As per the Gas Safety (Installation and Use) regulations 1998 (GS(I&U)R) suppliers must ensure that every part is of good construction, sound material, adequate strength and of a type appropriate to the gas. The mechanism by which this is demonstrated should be outlined during the early stage of the competition.

Deliverables: Outputs proposed will include a report, which will provide evidence of successful completion of required milestones (Section 7). Outputs of each project will also include:

- Monthly reports - Contractor monitors progress by all sub-contractors and reports receipt of components and supporting documentation. Progress of any component safety & functionality tests which have been completed in the period are included.
- Component test report – a summary of the components that have been demonstrated as suitable for use with hydrogen with the relevant specifications of the component's capabilities, supported by the relevant notified body certificates.
- One fully packaged example of each component including all paperwork and evidence proving the capability of the components for safe installation, operation and maintenance.

Timescale: Deliverables are required by March 2021. Within this timescale, delivery dates for the outputs detailed in Section 7 should be provided by the supplier.

2.4 Summary of Key Dates

The anticipated timetable for the competition and this tender exercise is as follows. BEIS reserves the right to vary this timetable. Any variations will be circulated by email to all organisations who have registered an interest in tendering.

WP5b Key Dates	
WP5b Briefing and industry engagement event	21 May 2019
Competition opens	2 August 2019
Briefing webinar	w/c 5 August 2019
Deadline for questions relating to the tender	16 August 2019
Responses to questions published	23 August 2019
Deadline for tender applications	Friday 13 September 2019, 12 Noon
Notification of competition results	11 October 2019
Standstill period	12 – 21 October 2019
Project Start / Finish	28 October 2019 – March 2021

3. Competition Process

BEIS is seeking proposals to deliver a portfolio of certified commercial hydrogen appliances, boiler cascade and ancillary system components for use in a commercial setting, in order to provide critical evidence of end use application and safety.

Contracts will be awarded on a competitive basis to the highest quality proposals that address the challenges set out in this guidance. Bids will be assessed against the evaluation criteria along with other bids within the same sub-lot. For appliance development, within each sub-lot, bids will be assessed along with those delivering the same requirements (core or core+).

It is anticipated that between one and three projects per sub-lot will be selected. The number of projects funded will be dependent on the quality of applications and funding available within the value of the competition. Funding will be allocated to the highest scoring bids in each sub-lot, and then allocated in ranked order from the highest scores in each sub-lot until the funding limit is reached.

Exceptions to this may include:

- Bids of insufficient quality;
- Bids that do not meet the ITT requirements;
- If funding has been allocated to identical technology of a higher score;
- If there is an imbalance of successful bids across the lots.

The Competition will proceed as follows:

- Competition documents released 2 August 2019;
- Briefing webinar w/c 5 August 2019 to be shared via email;
- Interested companies submit applications that are assessed against defined criteria;
- Contracts are awarded to the highest-ranking proposals; however, BEIS reserves the right to take a portfolio approach and may choose to allocate the budget to lower scoring projects as detailed above to ensure a range of appliances, boiler cascade and ancillary system components are procured;
- Milestone outputs are reviewed throughout the project to ensure completion and confirm project progression. Section 7 provides further detail of the milestone deliverables required.
- Contracted companies can further develop and exploit products or services, offer it to other customers and take it to market (complying with intellectual property requirements – see Section 10.5).

4. Application Process

Conflict of Interest

BEIS's terms and conditions of contract for the competition include reference to conflict of interest and require contractors to declare any potential conflict of interest to the Secretary of State.

For research and analysis, conflict of interest is defined as the presence of an interest or involvement of the contractor, subcontractor (or consortium member) which could affect the actual or perceived impartiality of the research or analysis.

Where there may be a potential conflict of interest, it is suggested that the consortia or organisation designs a working arrangement such that the findings cannot be influenced (or perceived to be influenced) by the organisation which is the owner of a potential conflict of interest. For example, consideration should be given to the different roles which organisations play in the research or analysis, and how these can be structured to ensure that an impartial approach to the project is maintained.

The process by which this is managed in the procurement process is as follows:

- **During the bidding process, organisations may contact BEIS, via the builtenvironmentinnovation@beis.gov.uk email address to discuss whether or not their proposed arrangement is likely to yield a conflict of interest.** Any responses given to individual organisations or consortia will be issued by email (in a form which does not reveal the questioner's identity). Any organisation thinking of submitting a bid, should share their contact details with the staff member responsible for this procurement, to ensure they receive an update when any responses to questions are published.
- **Contractors are asked to sign and return Declaration 3 (page 95) to indicate whether or not any conflict of interest may be, or be perceived to be, an issue.** If this is the case, the contractor or consortium should give a full account of the actions or processes that it will use to ensure that conflict of interest is avoided. In any statement of mitigating actions, contractors are expected to outline how they propose to achieve a robust, impartial and credible approach to the research.
- **When tenders are scored, this declaration will be subject to a pass/fail score,** according to whether, on the basis of the information in the proposal and declaration, there remains a conflict of interest which may affect the impartiality of the research.

Failure to declare or avoid conflict of interest at this or a later stage may result in exclusion from the procurement competition, or in BEIS exercising its right to terminate any contract awarded.

BEIS has appointed Arup+ as the programme management contractor (PMC), who is responsible for delivering work packages 1 and 9 as part of their contract. Arup+ will also be managing the delivery of Work Packages 2 – 8 and 10 and, as part of the conditions for the PMC role, have agreed not to bid for the remaining work packages. These work packages will be delivered by other suppliers.

Evaluation of Responses

The tender process will be conducted to ensure that bids are evaluated fairly and transparently, in accordance with agreed assessment criteria. Further details of the assessment criteria are provided in Section 8.

Terms and conditions applying to this Invitation to Tender (ITT)

BEIS Terms and Conditions of Contract for Services for SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component Development Competition (Hy4Heat - Work Package 5b) (TRN: 1996/07/2019) are published alongside this ITT.

Instructions to Contractors

BEIS reserves the right to amend the enclosed tender documents at any time prior to the deadline for receipt of tenders. Any such amendment will be numbered, dated and issued by 23 August 2019. Where amendments are significant, BEIS may at its discretion extend the deadline for receipt of tenders.

BEIS reserves the right to withdraw this contract opportunity without notice and will not be liable for any costs incurred by contractors during any stage of the process.

Contractors should also note that, in the event that a tender is considered to be fundamentally unacceptable on a key issue, regardless of its other merits, that tender may be rejected.

By issuing this invitation the department is not bound in any way and does not have to accept the highest scoring or any tender and reserves the right to accept a portion of any tender unless the tenderer expressly stipulates otherwise in their tender.

Applicants should endeavour to answer all of the questions on the application in full. Incomplete applications and any containing incorrect or false information are very likely to be rejected although BEIS may, at its discretion, request clarification or additional data before making a final decision. Applicants are strongly advised to structure their tender submissions to cover each of the evaluation criteria.

All answers should be contained within the application form. Any appendices that support the answers in the application form must be appended to the end of the form. The application form must list all appendices and supporting documents.

Any applications or supporting documentation received after the application deadline will not be considered.

After reviewing and evaluating the written proposals, BEIS may decide to seek clarifications from suppliers.

Registration of interest (RoI) for submitting an application

Tenderers should register their interest in submitting a tender for this project at both of the following email addresses:

builtenvironmentinnovation@beis.gov.uk

hy4heat@arup.com

The email must include the following subject line:

‘Registration of Interest: SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Components Development Competition’

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All updates to the Invitation to Tender (ITT) process or answers to questions raised by potential bidders will be uploaded to Contracts Finder⁶ and notifications of this will be sent via email, so it is important that you have registered your interest to receive them.

Submitting an application

The application form can be found at:

Annex 5 – Application Form

Completed application forms should be submitted electronically in **pdf format** and emailed to the following email address:

builtenvironmentinnovation@beis.gov.uk

with the following subject line:

‘TENDER: SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Components Development Competition’

The maximum size email you can send is 10 MB. If your application is larger than 10MB please break the submission down into smaller sizes and ensure the subject line of each additional email takes the following format:

‘TENDER: SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Components Development Competition’ – (name of lead applicant) – email x of y’

Checklist of documents to be submitted

For each project – a completed application must be submitted:

Annex 5 A. – Summary Information

Annex 5 B. Items 1, 2 and 3 - Proposal Details (maximum 15 A4 pages for each appliance type, Arial font minimum size 12pt with single spacing and minimum 2.5cm margins)

Annex 5 B. Item 4 – Pricing Schedule (*separate document*)

Declaration 1: Statement of Non-collusion

Declaration 2: Form of Tender

Declaration 3: Conflict of Interest

Declaration 4: Standard Selection Questionnaire

Declaration 5: Code of Practice for Research

Declaration 6: GDPR Assurance Questionnaire

Declaration 7: Safe Use of Hydrogen

⁶ “Contracts Finder” is the Government's publishing portal for public sector procurement opportunities.

5. Eligibility Criteria

BEIS expects to deliver the proposed Competition as a pre-commercial procurement which is aimed at organisations working on research and development (R&D) of an innovative process, material, device, product or service *prior to commercialisation*.

Funding is available for pre-commercial R&D activities only. Projects requesting funding for commercialisation activities are not eligible.

This Competition is ***open to all organisations*** that can demonstrate a route to market for their solution based on natural gas appliance and component sales.

The sharing of risks and benefits is an important aspect to the pre-commercial procurement approach. Projects receive financial support and retain any intellectual property generated, with certain rights of use retained by BEIS as set out in Annex 4 Terms & Conditions.

Project outputs are expected to be shared publicly (See 'Further Information' in Section 10).

Applicants should clearly state where cost savings are being provided compared to exclusive development contracts.⁷

Suppliers bidding for more than one project should provide details of any discount that they wish to offer on their costs. If they are awarded more than one project, to take account of any duplicated work in their multiple proposals. Any discount will not form part of the assessment of the cost but will be applied to the signed contracts.

Proposals must:

- Be at a pre-commercial stage of development⁸.
- Address the project scope (see Sections 6 and 7), specifically in meeting the needs of the commercial sector.
- Clearly indicate the cost savings, compared to exclusive development contracts, provided to BEIS in line with pre-commercial procurement requirements (see Financial Information, Section 10.2).
- Be led by a single organisation acting as prime contractor with evidence of strong collaboration across consortia (if a consortium bid is proposed).
- Provide heat as the primary function. i.e. products which dump heat in order to supply power (electricity) are out of scope.

⁷ Exclusive development means that the public purchaser reserves all the results and benefits of the development (including Intellectual Property Rights or IPRs) exclusively for its own use.

⁸ Pre-commercial covers activities such as solution exploration and design, prototyping, up to the original development of a limited volume of first products or services in the form of a test series. It does not include commercial development activities such as quantity production.

6. Project Scope

BEIS is seeking applications from contractors in order for BEIS to deliver a portfolio of commercial hydrogen appliances, boiler systems and ancillary system components as detailed in Annex 1. These products will support the evidence gathering for BEIS to demonstrate the convertibility of the commercial sector. The functional specifications for the scope of appliances, boiler cascade and ancillary system components are detailed in Annex 2.

BEIS reserves the right to take a portfolio approach when awarding funding to projects in order to ensure that the competition supports a range of commercial hydrogen appliances, boiler cascade, and system components across the sub-lots. It is anticipated that between one and three projects per sub-lot will be selected. The number of projects funded will be dependent on the quality of applications and funding available within the value of the competition. Funding will be allocated to the highest scoring bids in each sub-lot, and then allocated in ranked order from the highest scores in each sub-lot until the funding limit is reached.

Exceptions to this may include:

- Bids of insufficient quality;
- Bids that do not meet the ITT requirements;
- If funding has been allocated to identical technology of a higher score;
- If there is an imbalance of successful bids across the lots.

For a specific appliance sub-lot, if tenders received are only for 'hydrogen only' appliances with no acceptable tenders received for 'dual fuel', 'hydrogen ready' or 'adaptable' appliances, BEIS further reserves the right to only award part or none of the funding available for that sub-lot.

Lot	Sub-Lot	Example
LOT 1 Catering & Production Heating	LOT 1A ≤15 kW	Char Griddle
	LOT 1B 15 – 30 kW	4 Burner Hob
	LOT 1C ≥30 kW	Wok Burner
LOT 2 Dry Space Heating	LOT 2A ≤50 kW	Radiant plaque heater
	LOT 2B 50 – 120 kW	Cabinet heater
LOT 3 Wet Space Heating	LOT 3A	Burner integrated with a shell boiler (>400 kW)
	LOT 3B	Control for a boiler cascade (<400 kW)
LOT 4 Combined Heat & Power (CHP)		Fuel cell mCHP
LOT 5 Ancillary System Components		Components development

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Applications from manufacturers should be based on their own knowledge of existing markets for natural gas appliances and components. This should be used as a guide and justification as to which commercial hydrogen appliances, boiler systems and ancillary system components fit the scope of this requirement.

Applications for projects should propose:

- Either, appliances, boiler systems or components which exist for natural gas, a reference natural gas product with sufficient sales history to demonstrate its suitability as a 'like for like' replacement of a significant section of the market.
- Or innovative hydrogen appliances, with a potential market to deliver functions required by the commercial sector with an explanation of why they believe that this potential market exists. Such appliances must be designed to fulfil functions within the project scope.

Multiple applications

Manufacturers may submit more than one application for the same sub-lot if they are based on different reference products with fundamental differences in design i.e. these shall be with regards to such aspects as design of heat exchanger or the burner technology used. Differences that are solely aesthetic are not considered to be fundamental. Applicants wishing to bid for the development of more than one project must complete a separate application form for each proposal.

7. Deliverables

Contract delivery will be measured against predefined milestones. It should be noted that BEIS contracts require that project outputs are shared publicly. See 'Further Information' in Section 10.

7.1 Appliances (Lots 1, 2, 3A and 4)

Solution Design - Milestone 1

Manufacturers will be expected to deliver a feasibility report that describes the necessary product development steps and required outputs to achieve milestones 2 - 7. As a minimum, reports should include:

- Identification and assessment of the reference appliance regarding its suitability for development to a hydrogen appliance. This should include:
 - Evidence of significant ongoing market demand for the chosen natural gas appliance. For innovative commercial hydrogen appliances, this should be a justification of a potential market;
 - An explanation for why this appliance is particularly suited for development into a replacement hydrogen appliance from a technical and cost perspective.
- A description of the approach to develop the 'like for like' hydrogen appliance that acknowledges the risks involved and demonstrates how these will be avoided or mitigated to create a hydrogen appliance that is:
 - Safe;
 - Functional, in that it delivers a similar level or improved performance to the natural gas reference appliance;
 - Aesthetic in keeping with market expectations;
 - Compliant with the relevant standards and efficiency and emissions regulations if the scope of the project includes full certification (milestone 6b in the table below).
- A coherent explanation of the hydrogen combustion and heat exchanger technology (where relevant) that is planned, including diagrams of key components (e.g. burner, heat exchanger). Consideration should be given to all key challenges detailed in Section 2.
- Where projects are for 'hydrogen ready', 'dual fuel' or adaptable' appliances, a detailed description of functionality and key components should be provided, including estimates of conversion times and component costs.

The milestone 1 solution design report will be used to ensure projects will successfully deliver safety certified prototypes ahead of March 2021. The report should contain sufficient information to demonstrate this, BEIS reserve the right to request any further details beyond those provided.

Participants will also need to deliver fully accessible copies of any other relevant documentation or outputs used in delivery of milestone 1, with appropriate explanations of the analysis undertaken and raw data used. **This deliverable must be provided by 31 January 2020.**

Prototype Development - Milestones 2 - 7

Deliverables for all appliances are described in the table below. The optional milestone, 6b is included for suppliers able to deliver the core+ requirements of this ITT.

Delivery dates for the milestones detailed in the table below should be provided by the supplier as part of their application.

Milestone		Verification Method	Verification evidence required
1	Identification of design parameters for conversion to hydrogen (or development of an innovative domestic hydrogen appliance), especially burner and burner control unit	Document review	Feasibility report to demonstrate that the development of the hydrogen appliance is viable. The report should describe the necessary product development steps to create the safety certified prototype or fully certified appliance where applicable. This will include details of the 'reference product' (where relevant) and a list of the components to be changed e.g. gas/air mixture control, level of premix (see Section 8, Technical Approach). This deliverable must be provided by 31 January 2020.
2a	All components identified, including colourant method as required	Document review	First design review report to include: Confirmation that proposed hardware is as detailed in the milestone 1 report. Where design aspects have been changed, the following information is required: ○ Detail of changes made ○ Diagram of the proposed appliance ○ Exploded diagram of the proposed appliance showing assemblies and how they fit together ○ Exploded diagrams of all assemblies showing component parts and how they fit together. Bill of Materials (BoM) with descriptions of component function, reference part numbers and sub-contract suppliers (where relevant) provided for each. Each component listed should be described fully. Note gas carrying components must meet the essential requirements of the GAR. Description and design drawings of colourant method if applicable. A proposed methodology to test the longevity of colourant should be included.

2b	All components developed and tested for functionality and safety	Visit to confirm that each component works as specified	Provision of short summary document, prior to site visit to form basis of onsite verification, detailing the following: • Any changes to the design provided at milestone 2a during this development stage. • Any issues that will impact the delivery of the project, e.g. staff absence or component failure. Where issues have been identified, plans should be included to address these. • Records that show proposed components have passed functionality and safety testing. Progress visit to review the following: • Summary report and progress to date • Test equipment and methods including: ○ For gas carrying components, pressure tightness to 50 mbar ○ Where possible, burner performance is within limits; the flame is stable and lights easily. ○ FFD and/or other safety devices operate effectively. ○ If applicable, temperature of components and user-touchable parts are acceptable. ○ For fires, the fuel bed assembly should be demonstrated including colourant method. ○ For cookers the colourant method should be demonstrated. ○ For fires and cookers, the method to assess longevity of colourant should be demonstrated. ○ View selection of performance tests in progress.
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3	All component assemblies (e.g. burner/control assembly or heat exchanger) developed and tested for functionality and safety	Visit to confirm that each assembly works as specified	Provision of short summary document, prior to site visit to form basis of onsite verification, detailing the following: - Any changes to the design provided at milestone 2b during this development stage. - Any issues that will impact the delivery of the project, e.g. staff absence or component failure. Where issues have been identified, plans should be included to address these. - Records that show each assembly has passed functionality and safety testing. Progress visit to review the following: - Summary report and progress to date - Test equipment and methods including: - For gas carrying components, pressure tightness to 50 mbar - If applicable, unignited gas does not accumulate within the appliance - Where possible, burner assembly performance is within limits, e.g. the flame is stable, ignition is reliable and cross lighting is effective. - FFD and/or other safety devices operate reliably and effectively. - If applicable, temperature of components and user-touchable parts are acceptable. - For fires, assembly should be demonstrated within a working flue system showing flame picture and fuel bed arrangement. - For fires and cookers, results of colourant longevity testing to date should be available, including assessment of any impact on the condition of the fuel bed, flame strip or other associated components - For fuel cells, hydrogen clean-up assemblies will need to demonstrate that they can produce hydrogen of a quality suitable for the proposed cells. - View selection of performance tests in progress.
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4	Completion of appliance prototype 1.0 design and production of the first unit	Document review	Final prototype design review report, to include: • Final appliance design drawings • Final BoM with part numbers and sub-contract suppliers (where relevant) provided for each. Note; gas carrying components must meet the essential requirements of the GAR and evidence of suitability for use with hydrogen should be provided. • Description as to how the appliance meets the requirements of the functional specification and how the challenges have been addressed. To include detail of qualitative performance reviews, e.g. safety, functionality, usability, aesthetic appeal. ○ For cookers, evidence of cooking performance will be required. Further detail regarding this assessment will be provided by Hy4Heat. This will be based on tests such as those detailed in EN 12815 (solid fuel), BS 5386 (Gas, withdrawn) and EN 60350 (electric appliances). • Where there are outstanding performance and functional challenges, the report should detail further work to address these. • Photographs of prototype product including packaging and labelling • Risk assessment for reasonable or foreseeable use
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5	Appliance prototype 1.0 developed and tested for functionality, safety and rational use of energy	Visit to confirm that appliance works as specified	Progress visit to review the following: • Final prototype design review report (as delivered at milestone 4) and progress to date • Records that show the prototype appliance has passed functionality and safety testing. • Observe performance tests that demonstrate the following, (as a minimum, tests should show an appliance that can be safely lit, operate for an extended period (at least 30minutes), carry out its intended task, operate under automatic control (where relevant), and be safely shut down): ○ The completed prototype appliance performs as detailed in the final prototype design report. ○ For gas carrying components, pressure tightness to 50 mbar ○ Unignited gas does not accumulate within the appliance (risk of delayed ignition) ○ Burner control assembly performance is within limits, e.g. the flame is stable, ignition is reliable and cross lighting is effective and flame detection device is appropriate. ○ FFD and other safety devices operate reliably and effectively. ○ Temperature of components and user-touchable parts when assembled are acceptable and meet requirements of relevant standards and regulations. ○ Functionality and performance are acceptable to users, e.g. ease of use, speed of response, convenience. ○ All naked flames are visible ○ In addition, for fires; the flame picture is satisfactory and maintained.
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6	Production of five fully boxed examples of appliance prototype 1.0 including all paperwork and CE GAR type test report and demonstration of the prototype being safely installed, operated and maintained. NOTE: For Lot 4: Combined Heat and Power, only 1 fully boxed appliance needs to be delivered.	Visit to confirm that all the appliances work as specified and a review of the paperwork	Provision of five fully boxed examples of appliance prototype 1.0 to site to be specified by Hy4Heat. To include user, installation and maintenance instructions. NOTE: For Lot 4: Combined Heat and Power, only 1 fully boxed appliance needs to be delivered. Evidence of compliance with essential requirements of GAR for each appliance, valid for the demonstration trial. Declaration that support staff will be available for the duration of the unoccupied demonstration trial (Applicable to bids meeting core+ requirements only). Site visit to assess that: • The appliance has been installed in accordance with the manufacturer's instructions by a qualified person having undertaken a recognised and relevant qualification to provide competence in the relevant technology and registered with GasSafe. • The appliance operates in accordance with its specification and any current certification • The appliance operates as per the manufacturer's user instructions • The appliance has been commissioned at the time of installation and handover.
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6b (Optional)	Completion of appliance prototype (fully certified) design and presentation of one fully packaged example of appliance including all paperwork and CE GAR type test report	Visit to confirm that all the appliances work as specified and a review of the paperwork	Provision of one boxed example of appliance prototype 2.0. To include user, installation and maintenance instructions as per the requirements of the GAR. Short post production information package to include: • Detail of the outcome/findings of the demonstration trials and any subsequent changes made to the design of the appliance in light of this work. • Evidence that the developed appliance meets the requirements of the Functional Specification as detailed in the Invitation to Tender. Including efficiency and emissions • Evidence of compliance with the essential requirements of the GAR for each appliance. • Evidence of compliance with the requirements of the relevant Ecodesign regulations.
7	Final retention for training, guarantee issues and business cases etc.	Document review	Provision of final report including: • Business plan for scaling up manufacture • Training plan for installers in readiness for a possible community trial and subsequent sales. • Potential further product developments • Potential costs to consumer with regard a hydrogen transition • Where a dual fuel, hydrogen ready or adaptable appliance has not been produced, detail should be included as to how further product development could provide these capabilities, including likely cost, implications on performance and time to convert.

7.2 Boiler Cascade (Lot 3B)

Deliverables for the boiler cascade systems are as follows:

Milestone		Verification Method	Verification evidence required
1	Detailing of the existing cascade system	Document review	Report detailing existing boiler cascade system and the range of boiler installations to which it has been fitted. Details of the scope of the hydrogen boilers to which the cascade controller will be fitted.
2	Practical demonstration	Document review & site visit	Report submitted detailing adaption of the controller to supply up to 400kW of heat from hydrogen boilers. Demonstration by manufacturer of control of 4 (or more) hydrogen boilers to follow a heat demand varying in a rapid but realistic fashion from zero to 180/ 200kW at an agreed location. Submission of technical file which should comprise at least product technical specifications, image of baseline product, evidence of manufacturer assessment (including of appropriateness of materials), declaration that the product meets minimum performance characteristics described in this tender, Installation instructions, User Instructions.
3	Production of prototype including all paperwork	Document review	Contractor supplies one off example of a cascade controller with supporting information including operating and installation manuals.

7.3 Components Development (Lot 5)

Deliverables for the components are as follows:

Milestone		Verification Method	Verification evidence required
1	Detailing of the component list	Document review	Contractor provides a report describing the necessary steps required to procure the set of hydrogen ready components. - Detail of the intended procurement route taken for each component should be included. - Description of how achievement of the GS(I&U)R requirements for “appropriate fittings” will be demonstrated for each component including any certification routes. NOTE: communication of the demonstration will be through provision of product technical files to the Hy4Heat programme. - Where testing is necessary to demonstrate functionality or compatibility with hydrogen, 3rd party testing is preferred although other routes may be used provided that they can be demonstrated to be reliable. - Where an existing relevant certification route is available it should be utilised.
2	Component evidence submission	Document review	Component technical files submitted to Hy4Heat for assessment. Technical files should demonstrate compliance with the requirements set out in this ITT for Ancillary Components. Technical files should comprise at least product technical specifications, image of baseline product, evidence of manufacturer assessment (including of appropriateness of materials), any product testing, any product certification achieved, declaration that the product meets minimum performance characteristics described in this tender, Installation instructions, User Instructions.
3	Production of examples of components including all paperwork	Document review	Contractor supplies the agreed number of components of each type with supporting information including certification and installation manuals.

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If the contractor fails to deliver the milestone deliverables to the timeline and quality set by the supplier in their proposal, BEIS will request the Contractor to review and reschedule the services and a revised date for the milestone(s) delivery will be agreed.

If the Contractor subsequently fails to deliver the re-scheduled services by the revised date, a 28-day notice period will begin by which the service requirements for the milestone must be satisfactorily provided.

If, at the end of the 28-day notice period the requirements for the milestone(s) have not been delivered satisfactorily, BEIS reserves the right to terminate the contract.

8. Evaluation Criteria

The responses to tender should demonstrate your ability to cover the entire development and delivery contract, e.g. All milestones detailed in Section 7.

The tender response should show that the hardware is achievable in theory by describing the reference natural gas device and planned design approach to adapt/prove it appropriately. For Lots 1 – 4, this should describe the engineering principles that underpin the concept and how they will be applied in practice. Sufficient detail should be included to show your technical capabilities to complete the full development of the proposed appliance(s).

Each application will be assessed by three assessors, including Hy4Heat team representation. The cost criterion will be marked by BEIS staff only. Proposals will be assessed against each of the criteria in the table below. A total of five points is available against each sub-criterion and the weighting to be applied to each sub-criterion is given in brackets.

Due to the differing natures of the development work anticipated, different 'Technical Approach' criteria have been provided for the appliances, boiler systems and components.

Proposals must:

- Be at a pre-commercial stage of development⁹
- Address the scope (see Sections 6 and 7), specifically by meeting the needs of the commercial sector
- Clearly indicate the cost savings, compared to exclusive development contracts, provided to BEIS in line with pre-commercial procurement requirements (see Financial Information, Section 10.2)
- Be led by a single organisation acting as prime contractor with evidence of strong collaboration across consortia (if a consortium bid is proposed)
- Provide heat as the primary function. i.e. products which dump heat in order to supply power (electricity) are out of scope

⁹ Pre-commercial covers activities such as solution exploration and design, prototyping, up to the original development of a limited volume of first products or services in the form of a test series. It does not include commercial development activities such as quantity production.

1. Skills and Expertise (all Lots)

Total Score 20

- a. Evidence that the team has relevant skills and expertise to undertake the project, including demonstrating capability of working with hydrogen and/or town gas (*weighting x 2*);
- b. Details of project team including organisational structure. If your bid is a consortium, this should clearly state the consortium lead and details of each consortium member and their role (*weighting x 1*);
- c. Evidence of appropriate facilities (either existing or planned) that are required to undertake the project (*weighting x 1*).

2. Technical Approach

Total score 35

2i. Appliance Development (Lots 1, 2, 3A and 4)

- a. Provide a clear description of the proposed hydrogen appliance. Describe the approach and methodologies that will be applied to address the challenges defined in the ITT and any others which may be considered relevant (*weighting x 2*);
- b. Provide justification for the development of the proposed appliance and how this meets the requirements set out in the ITT, specifically Section 1.3 objectives. Where a reference appliance is applicable this should be based on sales, market share and future market trends. This should include:
 1. Photo/picture of base line reference appliance
 2. Technical specification
 3. Installation instructions
 4. User instructions

(Installation and user instructions may be provided as appendices)

(weighting x 2);
- c. Demonstrate how your proposal provides further value by developing 'dual fuel', 'hydrogen ready' or 'adaptable' variants to simplify the switch-over process or transition to hydrogen (*weighting x 2*);
- d. Include evidence that you understand the risks associated with hydrogen use and, in comparison to natural gas include reference to risks outlined in Section 10.1 (*weighting x 1*).

2ii. Boiler Cascade (Lot 3B)

- a. Provide a clear description of the proposed boiler cascade system and boiler into which it will be integrated, highlighting its suitability. Describe the approach and methodologies that will be applied to address the challenges defined in the ITT and any others which may be considered relevant (*weighting x 2*);
- b. Provide justification for the development of the proposed boiler system and how this meets the requirements set out in the ITT, specifically Section 1.3 objectives. Where a reference appliance is applicable this should be based on sales, market share and future market trends. This should include:
 - Photo/picture of base line reference appliance
 - Technical specification
 - Installation instructions
 - User instructions

(*Installation and user instructions may be provided as appendices*)

(*weighting x 2*);
- c. Demonstrate how your proposal provides further value by developing 'dual fuel', 'hydrogen ready' or 'adaptable' variants to simplify the switch-over process or transition to hydrogen (*weighting x 2*);
- d. Include evidence that you understand the risks associated with hydrogen use and, in comparison to natural gas include reference to risks outlined in Section 10.1 (*weighting x 1*).

2iii. Components Development (Lot 5)

- a. Provide a clear and comprehensive list of the ancillary components which are required for the installation of hydrogen appliances that the supplier can deliver.

Justify development of the proposed set of components based on sales, market share and future market trends of equivalent natural gas components. This should include:
 - Lists of base line components
 - Technical specifications
 - Installation instructions
 - User Instructions
 - Recommended retail price

(*weighting x 4*);

- b. Describe the approach and methodologies that will be applied to address the challenges defined in the ITT, specifically Section 1.3 objectives, and any others which may be considered relevant

(weighting x 2);

- c. Include evidence that you understand the risks associated with hydrogen use and, in comparison to natural gas include reference to risks outlined in Section 10.1.

(weighting x 1).

3. Management of delivery / Project Plan (all Lots)

Total score 20

- a. Detailed description of work and associated timelines to complete all milestones (include a Gantt chart)

(weighting x 1);

- b. Description of management plans to demonstrate how the project will be delivered alongside existing commitments. Include detail of your quality assurance procedures

(weighting x 1);

- c. Key risks relating to the delivery and dependencies of the project, including mitigation plans. Risks should be presented in the table provided in the application form and may include technical, user-related and safety aspects
(weighting x 2).

4. Cost (all Lots)

Total score 25

- a. Bid cost *(weighting x 5).*

Cost of projects should be provided for either:

- Lots 1, 2, 3A or 4 - Meeting the core requirement
OR
- Lots 1, 2, 3A or 4 – Meeting the core+ requirement
OR
- Lot 3B - Milestones 1 through 3 for boiler cascade
OR
- Lot 5 - Milestones 1 through 3 for ancillary system component development.

Price will be marked proportionately to the lowest bid within each sub-lot that is meeting the same requirements (i.e. core or core+ for appliance development). The lowest bid will receive maximum marks for the price element and then all other bids' prices will be marked proportionately to that bid, see example below.

If 25 marks are available and the cheapest bid is £48,000, then:

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Supplier	Price	Marks
1 (lowest bid)	£48,000	25
2	£53,000	$48/53 * 25 = 22.6$
3	£60,000	$48/60 * 25 = 20$

Scoring Method

Each question will be scored from one to five. The following illustrates the meaning of each score:

Score	Description
1	Not Satisfactory: Proposal contains significant shortcomings and does not meet the required standard
2	Partially Satisfactory: Proposal partially meets the required standard, with one or more moderate weaknesses or gaps
3	Satisfactory: Proposal mostly meets the required standard, with one or more minor weaknesses or gaps
4	Good: Proposal meets the required standard, with moderate levels of assurance
5	Excellent: Proposal fully meets the required standard with high levels of assurance

Contracts will be awarded to the highest-ranking proposals, which achieve a minimum pass mark of 60%, in order of ranking (based on the total score), however, the number of projects funded depends on the range of solutions proposed and the quality of the proposals. BEIS may allocate less than the total budget depending on the quality of the applications.

BEIS reserves the right to take a portfolio approach when awarding funding to projects to ensure that the Competition supports a range of appliances, boiler cascade and system components across the five lots. Within these lots, BEIS may therefore choose to allocate the budget to lower scoring projects to develop a wider range of appliance types. For a specific appliance type, if tenders received are only for 'hydrogen only' appliances with no acceptable tenders received for 'dual fuel', 'hydrogen ready' or 'adaptable' appliances, BEIS further reserves the right to only award part or none of the funding available for that appliance type. Furthermore, if no acceptable tenders are received for like-for-like appliances BEIS further reserves the right to award none of the funding available for that appliance type.

9. Support Available

The total value of the Competition is up to **£4.9m** (excluding VAT), although BEIS may allocate less than the total budget depending on the quality of the applications.

Bids will be evaluated within the same sub-lot as per the table below, showing expected funding levels within each sub-lot. Please note these are example funds for safety certified appliances (core requirement of this ITT) or the relevant non-power producing components, these are given as a guideline for the anticipated bid values.

As a guide, suppliers, who are delivering fully certified appliances may need to price up to 20% more, however this figure may vary.

Lot	Sub-Lot	Example funds per contract (excl. VAT)
LOT 1 Catering and Production Heating	LOT 1A ≤15 kW	£100,000
	LOT 1B 15 – 30 kW	£200,000
	LOT 1C ≥30 kW	£300,000
LOT 2 Dry Space Heating	LOT 2A ≤50 kW	£100,000
	LOT 2B 50-120 kW	£200,000
LOT 3 Wet Space Heating	LOT 3A Burner integrated with a shell boiler (>400 kW)	£200,000
	LOT 3B Control for a boiler cascade (<400 kW)	£150,000
LOT 4 Combined Heat & Power		£250,000
LOT 5 Ancillary System Components		£70,000

Funding under this Competition will only be **available until March 2021**. All activities and payments need to be completed by this date.

Consortia are welcome; however, applicants should note that BEIS will not fund development of consortia or team building. See Annex 3 for further details on eligible and ineligible costs.

Note: *Nothing in this funding call requires BEIS to award any applicant a contract of any particular amount or on any particular terms. BEIS reserves the right not to award any contracts, in particular if BEIS is not satisfied by the proposals received or if the funding assigned to the scheme is required for other, unforeseen, purposes. BEIS will not, under any circumstances, make any contribution to the costs of preparing proposals and applicants accept the risk that they may not be awarded a contract.*

9.1 Milestone payments

9.1.1 Appliance development (Lot 1, 2, 3A and 4)

Payment will be issued on milestone delivery. Funding payments for appliances meeting the core requirement of safety certification by March 2021 will be made as outlined in the table below and in line with the deliverables outlined in Section 7.

Milestone No.	Milestone	Payment
1	Design parameters for conversion to hydrogen, especially burner and burner control unit	15%
2a	All components identified, including colourant method as required	5%
2b	All components developed and tested for functionality and safety	10%
3	All component assemblies (e.g. burner/control assembly or heat exchanger) developed and tested for functionality and safety	15%
4	Completion of appliance prototype 1.0 design and production of the first unit	15%
5	Appliance prototype 1.0 developed and tested for functionality and safety	15%
6	Production of five fully boxed examples of appliance prototype 1.0 including all paperwork and CE GAR type test report and demonstration of the prototype being safely installed, operated and maintained. NOTE: For Lot 4: Combined Heat and Power, only 1 fully boxed appliance needs to be developed.	20%
7	Final retention for training, guarantee issues and business cases etc.	5%

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Suppliers meeting the core+ requirements as outlined in this ITT will be paid on milestone delivery as outlined below, please note that the core+ requirements are not available for boiler cascade and ancillary system components projects.

Milestone Payments for Core+

Milestone No.	Milestone	Payment
1	Design parameters for conversion to hydrogen, especially burner and burner control unit	10%
2a	All components identified, including colourant method as required	5%
2b	All components developed and tested for functionality and safety	10%
3	All component assemblies (e.g. burner/control assembly or heat exchanger) developed and tested for functionality and safety	10%
4	Completion of appliance prototype 1.0 design and production of the first unit	15%
5	Appliance prototype 1.0 developed and tested for functionality and safety	15%
6	Production of five fully boxed examples of appliance prototype 1.0 including all paperwork and CE GAR type test report and demonstration of the prototype being safely installed, operated and maintained. NOTE: For Lot 4: Combined Heat and Power, only 1 fully boxed appliance needs to be developed.	15%
6b	Completion of appliance prototype design and presentation of one fully boxed example of appliance including all paperwork and CE GAR type test report	15%
7	Final retention for training, guarantee issues and business cases etc.	5%

9.1.2 Boiler Cascade (Lot 3B)

Funding payments for the development of boiler cascades will be made as outlined in the table below and in line with the deliverables outlined in Section 7.

Milestone		Payment
1	Detailing of the existing cascade system	20%
2	Practical demonstration	50%
3	Production of prototype including all paperwork	30%

9.1.3 Components Development (Lot 5)

Funding payments for the development of ancillary system components will be made as outlined in the table below and in line with the deliverables outlined in Section 7.

Milestone		Payment
1	Detailing of the component list	20%
2	Component evidence submission	50%
3	Production of examples of components including all paperwork	30%

10. Further Information

10.1 Safe use of Hydrogen

Hydrogen offers a different set of risks to natural gas (NG) and liquid petroleum gas (LPG). Similarly to NG and LPG, these surround its flammability. Hydrogen is non-toxic and offers no risk of carbon monoxide (CO) poisoning. As part of this tender document manufacturers are required to declare that their R&D staff are safe and competent in the handling and combustion of hydrogen and as a minimum have read and understood the public literature (including for example product standards for hydrogen fuel cells) on the use and combustion of hydrogen. The knowledge so gained (which could be supplemented by training and or working with appropriate consultants) will then be applied. Specific examples of this might be related to ATEX zoning, the increased risk from delayed ignition, and the use of compressed hydrogen gas in a development laboratory context.

Bidders must sign and return Declaration 7 – Safe Use of Hydrogen (Annex 5).

10.2 Financial Information

Applicants are requested to provide a fixed price quotation for delivery of either:

- Lots 1, 2, 3A or 4 - Meeting the core requirement
OR
- Lots 1, 2, 3A or 4 – Meeting the core+ requirement
OR
- Lot 3B - Milestones 1 through to 3 for boiler cascade
OR
- Lot 5 - Milestones 1 through to 3 for ancillary system component development.

The total fixed price will be the financial criterion against which bids will be assessed within each sub-lot.

Financial information should include estimated costs for the project, detailing items such as labour, material and capital equipment costs, travel and expenses. A detailed cost breakdown is required to enable assessment of value for money.

Financial information should clearly indicate the cost savings / discount applied compared to an exclusive development contract¹⁰.

In submitting full tenders, applicants confirm in writing that the price offered will be held for a minimum of 13 weeks from the date of submission. Any payment conditions applicable to the prime contractor must also be replicated with sub-contractors.

¹⁰ Exclusive development means that the public purchaser reserves all the results and benefits of the development (including Intellectual Property Rights or IPRs) exclusively for its own use.

10.3 Publication of Results

Pre-commercial procurement involves a high degree of risk / benefit sharing. In return for provision of funding and non-financial support during demonstration activities, BEIS expects to be able to use and share the results and outputs of the demonstration activities with other Government Departments, industry and other stakeholders to further understanding and progress technology development and deployment.

BEIS also wishes to publicise details of the award recipients. Therefore, on or after issuing a pre-commercial procurement contract, BEIS will publish the following information on Contracts Finder:

- Identity of the participant and its partners;
- Project summary information including aims and expected outcomes of the project and technology area;
- Total award value.

Following completion of the funded projects, BEIS may wish to publish on its website a summary of the funded activities and the outcomes achieved. This will include a final summary report from each project detailing technical approach, key achievements and recommendations. BEIS may also revisit projects at a later date and publish research and/or evaluation reports for the scheme as a whole.

In addition to the above, BEIS is required to publish information about this contract through the Government's Transparency website, Contracts Finder.

BEIS however recognise the need to maintain confidentiality of commercially sensitive information. Where there is discretion, BEIS will consult applicants regarding the nature of information to be published, in order to protect commercially sensitive information

10.4 Reporting, evaluation & knowledge sharing requirements

There will be a number of requirements on contractors during the course of the project. These are described in more detail in Section 2, but for clarity, these will at a minimum include:

Reporting: to track project progress and ensure payments are made according to a schedule of milestones to be agreed with selected projects. This reporting will be in confidence to BEIS and will not be published. Any changes to schedules or project plans will need to be discussed with BEIS and applicants should expect significant interaction with the team during the project. Any public reporting by BEIS on the progress of the Hy4Heat programme will be anonymised and circulated for comment to the programme participants prior to publication.

Research and evaluation of the scheme: Successful applicants will be expected to participate in research and evaluation activities of their project during and after final contract payments, to assess the impact of the project including value for money. For example, during the project, successful applicants will be expected to grant access to their facilities so BEIS's agents may verify the progress being claimed prior to recommending that a milestone payment be made.

Knowledge sharing: to improve understanding of this technology and share lessons learned there will be an obligation on successful applicants to undertake knowledge sharing activities. We will expect applicants to share useful data (including performance data collected during field trials) and experience, for example through relevant industry forums. If it becomes apparent that a participant is having difficulty solving a problem that another participant has already solved, both parties will be encouraged to share their respective experiences to maximise the number of certified appliances that are delivered by the end of the Hy4Heat programme.

10.5 Intellectual Property

Suppliers will retain the intellectual property generated from the project and will be expected to identify and protect patentable knowledge within three years of its creation. Costs associated with securing intellectual property arising from or associated with this project are not eligible for reimbursement and cannot be included within the contract price.

BEIS requires a UK wide, irrevocable, royalty-free, non-exclusive licence, together with the right to grant sub-licences, to use or publish information, data, results, outcomes or conclusions which are created in performing the project, for its internal non-commercial purposes.

The detailed arrangements for intellectual property rights and exploitation of IPR are set out in the Terms and Conditions for this Competition.

10.6 Ownership of Demonstration Devices

Chosen suppliers will retain responsibility and ownership for the technologies and related equipment developed and used during the delivery of the contracts.

10.7 Decommissioning Costs

Chosen suppliers will have responsibility for decommissioning demonstration equipment when the project has been completed. When bidding, suppliers need to include any decommissioning costs, at fair market value, in the total cost of their bid.

10.8 Quality Assurance

This project must comply with the BEIS Code of Practice for Research (Annex 6) and bidders must set out their approach to quality assurance in their response to this ITT.

Tenderers should include a quality assurance plan that they will apply to the project.

To demonstrate relevant experience in producing high quality reporting, the tenderer must:

Specify who will be responsible for quality assurance. This must be undertaken before information is issued to Hy4Heat for review prior to submission to BEIS.

Specify the specific responsibilities of the contractor's project manager / director.

Sign-off for the quality assurance must be done by someone of sufficient seniority within the contractor organisation to be able take responsibility for the work done. Acceptance of the work by BEIS will take this into consideration. BEIS reserves the right to refuse to sign off outputs which do not meet the required standard specified in this invitation to tender.

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The successful bidder or prime contractor in a consortium, will be responsible for any work they or their sub-contractors within the consortium supply and should therefore provide assurance that all work in the contract is undertaken in accordance with the Code of Practice.

BEIS reserves the right to request an audit of projects against the BEIS Code of Practice for Research and the commitments made in the tender documents and subsequent contract. Your response could be automatically rejected if the project will not be performed under quality assurance measures that fully meet the Code's requirements.

Other useful sources of guidance and advice that will help bids and the resulting work be of the highest quality include:

The Government Social Research (GSR) Code, in particular those that relate to GSR Products: <http://www.civilservice.gov.uk/networks/gsr/gsr-code>

The Green Book: appraisal and evaluation in central government. <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>

Quality in Qualitative Evaluation: A Framework for assessing research evidence provides a Framework for appraising the quality of qualitative evaluations.

Rapid Evidence Assessment (REA): <http://www.civilservice.gov.uk/networks/gsr/resources-and-guidance/rapid-evidence-assessment/what-is>. This toolkit will help researchers to identify whether a Rapid Evidence Assessment is best for their needs, and help with the process of planning and carrying out a review

Where relevant, all bids should refer to these pieces of guidance and advice and how they will be used.

The Contractor will be expected to produce high quality reports that meet the following criteria:

General:

They answer the research questions clearly, in plain English

They are clearly structured so that information presented in each section of each report is clear

Connections between sections are clear

Executive summaries are no more than two sides and set out the findings clearly and their relevance to BEIS policies

All sections have clear introductions and conclusions (including findings being written concisely upfront)

Use of good quality English:

They are thoroughly peer reviewed for writing quality

No jargon is used and all terms are defined and referenced clearly

All acronyms are written out in full the first time that they are mentioned in each section of each report

No grammar and phrasing errors are present

No typos / typographical errors are present

They contain concise and non-wordy sentences and paragraphs

They are concise reports that are not too long and do not have vast annexes

Visualisations:

All visualisations are labelled

All axes are labelled, including with appropriate units

Clear and appropriate use of visualisations (large enough size, data can be read clearly without reference to the raw data, and there are not too many visualisations presented at once)

All visualisations are clearly explained and discussed

A range of different types of visualisations are used to provide more interesting and innovative ways of presenting the results

Data quality:

Any limitations in the research approach need to be clearly stated and justified

Further research should be stated to build upon the limitations that cannot be addressed in the research

Where the findings are stronger and more robust and where they are not needs to be stated clearly

They must use appropriate and consistent units

All numerical units should include the range of uncertainty / error margin

10.9 Ethics

All applicants will need to identify and propose arrangements for initial scrutiny and on-going monitoring of ethical issues. The appropriate handling of ethical issues will be taken into consideration within the evaluation of applicants' proposals.

We expect contractors to adhere to the following GSR Principles:

- Sound application and conduct of social research methods and appropriate dissemination and utilisation of findings
- Participation based on valid consent
- Enabling participation
- Avoidance of personal harm
- Non-disclosure of identity and personal information

10.10 Consortium Bids / Conflicts of Interest

In the case of a consortium tender, only one submission covering all of the partners is required but consortia are advised to make clear the proposed role that each partner will play in performing the contract as per the requirements of the technical specification. We expect the bidder to indicate who in the consortium will be the lead contact for this project, and the organisation and governance associated with the consortia.

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Tenderers must provide details as to how they will manage any sub-contractors engaged to deliver this tender and what percentage of the tendered activity (in terms of monetary value) will be sub-contracted.

If a consortium is not proposing to form a corporate entity, full details of alternative proposed arrangements should be provided in Annex 5. However, please note that BEIS reserves the right to require a successful consortium to form a single legal entity.

BEIS recognises that arrangements in relation to consortia may (within limits) be subject to future change. Potential providers should therefore respond in the light of the arrangements as currently envisaged. Potential providers are reminded that any future proposed change in relation to consortia must be notified to BEIS so that it can make a further assessment by applying the selection criteria to the new information provided.

Annex 1: Recommended scope of products developed

The lots and specifications are based on market knowledge and stakeholder engagement conducted by the Hy4Heat team. Specifications were designed to establish the products that will demonstrate effectively the convertibility of activities in the commercial sector from use of natural gas to the use of hydrogen, as well as providing evidence for the use of hydrogen for heat in buildings.

This scope covers only technologies that are considered not to be being developed through other Hy4Heat work packages, or under other government funded innovation activities.

Applications for support of appliance development must be for one of the following categories of capability:

- 'hydrogen only' - designed to operate solely with hydrogen
- 'hydrogen ready' - Refers to appliances that are optimally designed to run on hydrogen but initially configured to run on natural gas. These appliances then may require a minimum number of components to be changed at the point of switchover but will have been specifically developed to facilitate this process. Definition adapted from BEIS commissioned report 'Appraisal of Domestic Hydrogen Appliances', Frazer-Nash Consultancy, February 2018.
- 'adaptable' - Refers to the replacement of a minimal number of key components within existing natural gas appliances to allow them to run on hydrogen. designed to be able to be configured after installation to operate either with hydrogen or with natural gas
- 'dual fuel' - designed to operate with both wholly hydrogen and with wholly natural gas without the need for intervention by either the user or an engineer
NOTE: appliances exist which are able to detect whether they are connected to a supply of natural gas or to a supply of liquified petroleum gas (LPG) but this has not been demonstrated where the possible gas supplies include one of nominal 100% hydrogen.

For the ancillary system components lot, the range of specific components is expected to be significant. Organisations with detailed knowledge of the gas components supply chains will need to be involved in this procurement such as trade wholesalers and merchants.

All appliance, boiler cascade, and ancillary system components development supported by this work package of the Hy4Heat programme shall be undertaken within the following context:

- The hydrogen supply shall be assumed to be as defined in Annex 2
- Products must provide one or more of the specified functionalities
- Product design should aim to ensure installation convenience e.g. by using similar dimensions and connectivity to those for gas appliances delivering the same functionality

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- Product design should aim to ensure user acceptability e.g. by maintaining aesthetic appeal, appliance usability and having functionality at least as good as the natural gas product functionality
- Product design should include consideration of and specification of servicing requirements which should be no more onerous than those for equivalent natural gas products
- Appliances that dump heat are not in the scope of this ITT even if this is done to enable them to provide one of the functionalities specified
- Appliances designed solely for domestic use, including such appliances as 'back boilers', are not in the scope of this ITT
- The initial objective is to demonstrate hydrogen can be used safely and effectively to provide functions for the commercial sector as set out in Annex 2
- Intent to achieve NOx emission and efficiency thresholds set out in relevant regulations and/or standards is desirable

Function	Appliance Scope	Examples (not an exhaustive list)
LOT 1 Catering & Production heating (see Annex 2 for details)	Appliances relying on open atmospheric burners Appliances relying on enclosed atmospheric burners Appliances relying on induced or forced draft pressure jet burners Appliances relying on unconventional heat generation technology	Hobs Bunsen and other micro burners Catering ovens Range fryers Hotplates Metallic foam burners
LOT 2 Dry, space heating (heat is transmitted by radiation directly from 'heat emitters' or by forced circulation of warm air)	Appliances relying on induced or forced draft pressure jet burners Appliances relying on catalytic burners	Gas fired warm air heaters Radiant tube heaters Radiant panels
LOT 3 Wet, space heating/ indirect production of sanitary hot water (heat is transmitted by circulation of heated water through heat emitters such as radiator panels, underfloor heating loops to spaces, or, through plate heat exchangers for sanitary hot water production)	LOT 3A Appliances that produce hot water for the purpose of providing space heating or for indirect production of sanitary hot water (>400 kW)	Packaged boiler with boiler body and separate burner, rated above 400kW i.e. outside of the scope of the Ecodesign / Boiler Efficiency regulations
	LOT 3B Controls to enable cascades of domestic hydrogen boilers (existing or under development) to be operated safely, efficiently to heat commercial premises providing power output of <400 kW.	Boiler control system

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LOT 4 Combined Heat & Power (CHP)	Appliances that demonstrate that heat functions can be provided using hydrogen and CHP. Combined Heat and Power is the simultaneous generation of heat and power (usually electricity) in a single process. This lot does not cover fundamental research of the proposed technology to be included in the system, Bids should aim to repurpose a proven technology.	Heat led, fuel cell based mCHP Stirling Engine mCHP Internal Combustion Engine mCHP
LOT 5 Ancillary System Components	Components necessary for the safe installation of hydrogen fuelled appliances	Demonstration of a catalogue of components such as pipes, fittings, regulators, valves, etc.

Annex 2: Product Specifications

Information for All Products

NOTE: Some of this information may not apply to all ancillary system components in Lot 5.

It is expected that any product developed under the Hy4Heat programme has comparable performance to its reference natural gas appliance. Users should be provided with the same heat output and functionality.

The environmental impact in terms of point of use and life cycle emissions from the new appliance should not be higher than that of the current natural gas appliance.

Within the Hy4Heat programme a small unoccupied demonstration trial will take place. The appliances procured under this Work Package may be used for this trial.

Gas Quality

Proposed quality from Hy4Heat Work Package 2 as defined in Figure 1, below.

Odorant

Leak detection is a fundamental safety requisite under the Health and Safety Gas Safety (Management) Regulations 1996¹¹. In natural gas, this is likely to be achieved using the addition of an odorant consisting of t-butyl mercaptan (TBM) and dimethyl sulphide (Odorant NB), at a concentration of 6 to 7 mg/m³ gas.

The same odorant is assumed for use with hydrogen in the unoccupied demonstration trial.

Supply Pressure

The hydrogen supply pressure to the property Emergency Control Valve (ECV) will be comparable to the current supply of natural gas in the low-pressure network, at 0.07 to 0.025 bar. The same meter regulators will be used as for natural gas and internal carcass pressure is expected to be nominally 20mbar i.e. similar to natural gas.

Certification/Compliance

Delivered appliances will need to meet legal requirements for the UK with regards to safety and functionality. It is expected that the same certification procedure as would be carried out for a natural gas product will be completed for the hydrogen appliance.

For gas appliances and potentially for some gas carrying components the main relevant legislation is Gas Appliances Regulation (GAR)¹²

¹¹ UK Government. HEALTH AND SAFETY Gas Safety (Management) Regulations 1996, SCHEDULE 3 CONTENT AND OTHER CHARACTERISTICS OF GAS PART I REQUIREMENTS UNDER NORMAL CONDITIONS

¹² Regulation (EU) 2016/426 of the European Parliament and of the Council of 9 March 2016 on appliances burning gaseous fuels and repealing Directive 2009/142/EC. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016R0426> (13/04/18)

The focus of the GAR is on the safety of appliances and fittings (in this context fittings are parts that will be incorporated into an appliance). In following sections some key areas are identified, particularly those where the impacts of the use of hydrogen will need special consideration.

For components used in in the gas supply train, which may be outside the scope of GAR the GS(I&U)R 1998 applies.

Depending on the appliance type and function other legislation may also apply including:

- Construction Products Regulation¹³
- Standards for some gas connection components are harmonised under this regulation
- Ecodesign regulations

These deal with appliance efficiency and emission performance. It is desirable that responses to this ITT should aspire to achieve compliance with any relevant ecodesign regulation it is accepted that this may not be achievable within the timescale available for the delivery of products under this Work Package.

WRAS (Water Supply (Water Fittings) Regulations or Scottish Byelaws)¹⁴

These regulations apply to appliances connected to a potable water supply. Compliance may be time consuming to demonstrate and it is accepted that it might not be achievable within the timescale available for the delivery of products under this Work Package.

Safety – General

(Ref: GAR, Annex I Essential Requirements)

All developed appliances must be safe and fit for purpose for use with hydrogen as a fuel gas.

Appliances (and where appropriate components) delivered for this Work Package must be demonstrated to comply with the essential requirements of the GAR by undertaking type testing and certification by a suitably approved Notified Body. Manufacturers are expected to determine the appropriate standards and testing procedures, working with their Notified Body as necessary. Hy4Heat's Work Package 3 (PAS4444) is currently looking to develop information to assist this process.

It is required that certificates issued during the development of appliances under this work package (commercial hydrogen appliances) are (as a minimum) of sufficient duration to cover the duration of the unoccupied demonstration trial. It is accepted that these may be location limited.

¹³ Regulation (EU) no. 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

¹⁴ Water Industry, England and Wales. The Water Supply (Water Fittings) Regulations 1999, Statutory Instruments No.1148. Available at: http://www.legislation.gov.uk/ukSI/1999/1148/pdfs/ukSI_19991148_en.pdf (16/04/2018).

Safety – Delayed Ignition

(Ref: GAR, Annex I Essential Requirements, 3.2 Unburned gas release)

A leak, or a release within an appliance of fuel gas can lead to an accumulation of unignited gas. Such accumulations present risks of fire and/or explosion. Subsequent ignition of such gas accumulations is referred to as 'delayed ignition'. For natural gas, incidents resulting from such events are rare. However, hydrogen has a lower ignition energy (by an order of magnitude) and higher flame speed than natural gas, so the probability of accumulations igniting is higher and potential effect of such an event is greater.

Delayed ignition within appliance combustion chambers should be considered, taking into account appropriate technical standards. Manufacturers of appliances will need to demonstrate understanding of the potential consequences of hydrogen accumulation within an appliance casing. Physical testing should be used to provide designers with information about how delayed ignition events occur and the effect on the appliance and on the environment within which it was sited. It will provide information to inform the design of mitigation options.

Such testing should only be undertaken in suitable locations and only once the necessary risk assessments have been completed and acted upon, and health and safety procedures are in place.

Mitigations might include gas detection within the appliance case or other integral space where hydrogen might be able to accumulate. NOTE: The behaviour of hydrogen described above, and the potential for a rapid transition from deflagration to detonation means that conventional pressure relief devices may not be effective at mitigating the impact of delayed ignition events.

Safety – Flame Detection

The hydrogen specification for the appliance development elements of this programme contains low concentrations of compounds containing carbon and very few impurities so its flame characteristics differ from those for natural gas. Therefore, means of flame detection need to accommodate this and will be different to those used for natural gas. It is expected that appropriate flame detection devices are included in all appliances supplied within the Hy4Heat programme. Detection must be directly of the flame and inferences from temperatures elsewhere in the appliance will not be sufficient. Potential methods include, but may not be limited to, detection of:

- Ultra-violet (UV) radiation
- Visible light (by flame colourisation)
- Infrared (IR) radiation
- Temperature (Thermal)

Safety – Flue Considerations

Two clauses of Part J of the Building Regulations are of particular relevance to combustion appliances under this Work Package:

Part J Combustion Appliances and Fuel Storage Systems

Air supply

J1. Combustion appliances shall be so installed that there is an adequate supply of air to them for combustion, to prevent overheating and for the efficient working of any flue.

Discharge of products of combustion

J2. Combustion appliances shall have adequate provision for the discharge of products of combustion to the outside air

Flue requirements for combustion appliances are covered under Approved Document Approved Document J- Combustion appliances and Fuel Storage ¹⁵. The exceptions to this are flueless appliances.

For hydrogen appliances, condensate is an important consideration as approximately 40% more water is produced (at stoichiometric combustion) per MJ of heat input than for natural gas. Manufacturers must consider ways to mitigate the risks associated with condensation such as corrosion, damp and mould development.

As for natural gas, appliance manufacturers must offer precise criteria for determining the suitability of any flue for hydrogen appliances.

Safety – Installation and operational documentation

(Ref: GAR, Annex I Essential Requirements, 1.5)

A full set of installation and operational documentation as required under the GAR will be required and are expected to be closely based upon any reference natural gas appliance. Documents include:

- Instructions for installation intended for the installer
- Instructions for use and servicing, intended for the user
- Appropriate warning notices, which shall also appear on the packaging

In addition, any documentation and labelling requirements as specified by the eco-design regulations should also be adhered to.

The full set of documentation for the equivalent natural gas product will be used as a reference point.

Advice to installation technicians

Appliances within the unoccupied demonstration trial and any possible future occupied trials will be installed by 'Gas Safe' registered personnel. Such staff usually receive their core training with natural gas. There is an expectation that engineers will have undergone specific hydrogen training and assessment prior to such installations. It is likely that these hydrogen specific assessments will follow a similar process to LPG, where additional conversion modules are available.

Manufacturers will be expected to co-operate with hydrogen specific training and provide bespoke advice on their products. They are also expected to ensure that their installations are safe and that their own engineers are appropriately trained on working with hydrogen gas.

¹⁵ Approved Document J, Combustion appliances and fuel storage systems. The Building Regulations 2010, HM Government. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/468872/ADJ_LOCKED.pdf

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Figure 1: Draft recommendation for a UK hydrogen quality standard for heat applications based on existing standards and documents

Content or characteristic	Value	Rationale
Hydrogen fuel index (minimum mole fraction)	98% (cmol mol ⁻¹)	This value is a good compromise between hydrogen cost and effects on boiler
Carbon monoxide	20ppm (μmol mol ⁻¹)	A practical engineering limit based on achievable production limits and to meet long term exposure limits HSE EH/40)
Hydrogen sulphide content	≤5 mg m ⁻³ 3.5 ppm (μmol mol ⁻¹)	These values are taken from GSMR: 1996 as any detrimental effects would be similar for hydrogen and natural gas
Total sulphur content (including H ₂ S and odorant)	≤50 mg m ⁻³ 35 ppm (μmol mol ⁻¹)	
Oxygen content	≤0.2% (cmol mol ⁻¹)	
Hydrocarbon dewpoint	-2°C	Complies with GSMR: 199 and EASEE- gas No detrimental effects to boiler, this limit is to reduce carbon content of the exhaust
Water dewpoint	-10 °C	
Sum of methane, carbon dioxide and total hydrocarbons	≤ 1% (cmol mol ⁻¹)	
Sum of argon, nitrogen and helium	≤ 2% (cmol mol ⁻¹)	To avoid transporting inert gases with no calorific value in the hydrogen gas (in agreement with ISO/FDIS 14687) and to limit the impact on Wobbe Number (see below)
Wobbe Number range	42-46 MJ m ⁻³	Range and percentage variation based on natural gas range in GSMR: 1996 Wobbe Number is calculated at UK metric standard conditions of 15 °C and 101.325 kPa
Other impurities	The gas shall not contain solid, liquid or gaseous material that might interfere with the integrity or operation of pipes or any gas appliance, within the meaning of regulation 2(1) of the Gas Safety (Installation and Use) Regulation 1998, that a consumer could reasonably be expected to operate	

Function Specification – Lot 1 Catering & Production heating

The focus for Work Package 5 for this function is on provision of catering equipment although bids are sought for any widely selling gas fired product that is non domestic and not specifically included in Lots 2, 3 and 4 (below).

Appliances procured for this programme will need to reflect the current market. Hydrogen appliances should be designed to enable straight-forward replacement of existing gas appliances.

Compliance – Safety and Function

GAR

The delivered product must be demonstrated to comply with the essential requirements of the GAR by undertaking type testing and on-going certification by a suitably approved Notified Body. Manufacturers are expected to determine the appropriate standards and testing procedures, working with their Notified Body as necessary. Hy4Heat's Work Package 3 is currently looking to develop information to assist this process.

Additional consideration of hydrogen safety may be based upon BS EN 62282-3-100:2012, and BS EN 62282-3-400.

It is required that certificates issued during the development of appliances under this work package are (as a minimum) of sufficient duration to cover the duration of the unoccupied demonstration trial. It is accepted that these may be location limited.

WRAS

Approval as appropriate would be expected and would need to be demonstrated by the provision of a WRAS approval certificate for potable water.

Flame visibility

Open flame cooking appliances are required to include within their design a method to make the flame visible. This is expected to be through the use of a flame colourant. Manufacturers should give careful consideration as to the longevity of such colourant source and the ability of users to refresh the colorant without the need to 'work' on the appliance (as defined by the GS(I&U)R 1998).

The flame colour as seen with the naked eye should be of similar intensity to that emitted by natural gas. Any proposed colourants should require no more than a few parts per billion to provide suitable levels of flame visibility. Only alkali metal salts are suggested as potentially suitable at this stage. It may be appropriate for confirmation of operation of flame colourant systems to be specified in appliance instruction documents with the maintenance actions which may be undertaken by a competent engineer (Gas Safe registered).

Functionality

Manufacturers are expected to determine the 'bake quality' produced by the hydrogen appliance and ensure comparable standards to those achieved using a natural gas appliance.

At stoichiometric conditions 40% more water vapour is produced when burning hydrogen compared to natural gas. Therefore, ovens with open flames will be 'wetter' than the same oven using natural gas. This could have a significant impact on roasting and baking and must be a consideration.

Compliance – Performance

Commercial cooking appliances are not covered by ecodesign regulations. Therefore, the regulatory control of efficiency is through the GAR requirement 'Rational use of energy' which requires:

"Appliances shall be so designed and constructed as to ensure rational use of energy, reflecting the state of the art and taking into account safety aspects."

For catering appliances for the commercial sector the EN 203 series of standards is relevant. Although the relevant gas types are not stated explicitly the testing requirements relate to the gases defined in the EN437. However, Rational use of Energy thresholds are provided for various appliance types. Where specified these provide the objective for demonstration of rational use of energy.

Compliance with performance requirements of relevant regulations is not mandatory for this Work Package. However, manufacturers are encouraged to aim to achieve this if possible.

Function Specifications – Lot 2 Dry, space heating

It is anticipated that for this programme a range of appliances may include:

- Warm air heating appliances – these are specifically designed to provide space heating by using the heat generated by a burner to raise the air temperature in the space(s) being heated
- Radiant heating appliances – these are specifically designed to heat people or objects in the space below them by infrared radiation without heating the surrounding air directly

Warm air heating appliances are expected to be indirect fired packaged warm air heater either units or modules which include necessary controls to ensure safe and efficient operation whilst firing hydrogen.

Radiant tube heating appliances are expected to be unitary, multi-burner or continuous and either units or packages which include necessary controls to ensure safe and efficient operation whilst firing hydrogen.

Radiant plaque and cone heating appliances are expected to be either units or packages which include necessary controls to ensure safe and efficient operation whilst firing hydrogen.

Appliances procured for this programme will need to reflect the current market. Therefore, manufacturers are strongly encouraged to develop hydrogen products based on products already developed for natural gas.

Appliance replacement should be as straight forward as possible.

The scope of this work package with regards to radiant and warm air heaters is limited to units which fall within the scope either of the ecodesign regulation 2015/1188¹⁶ (which includes radiant heaters with nominal heat outputs of up to 120kW per product or product segment) or ecodesign regulation 2016/2281¹⁷ (which includes air heaters with rated heating capacities up to 1MW).

Compliance – Safety and Function

GAR

Appliances delivered for this Work Package must be demonstrated to comply with the essential requirements of the GAR by undertaking type testing and certification by a suitably approved Notified Body. Manufacturers are expected to determine the appropriate standards and testing procedures, working with their Notified Body as necessary. Hy4Heat's Work Package 3 (PAS4444) is currently looking to develop information to assist this process.

It is required that certificates issued during the development of appliances under this Work Package (commercial hydrogen appliances) are (as a minimum) of sufficient duration to cover the duration of the unoccupied demonstration trial. It is accepted these certificates may be location limited.

¹⁶ COMMISSION REGULATION (EU) 2015/1188 of 28 April 2015 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for local space heaters

¹⁷ COMMISSION REGULATION (EU) 2016/2281 of 30 November 2016 implementing Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for energy-related products, with regard to ecodesign requirements for air heating products, cooling products, high temperature process chillers and fan coil units

CPR

Some radiant and forced convection warm air heating appliances fall within the scope of the Construction Products Regulations. Products of these types should demonstrate conformity with the relevant standards harmonised under the regulation. These include:

Standard	Coverage
EN 416-1:2009 – Single burner gas-fired overhead radiant tube heaters for non-domestic use – Part 1: Safety	Appliances with net heat input up to 120kW net, that do not use fully pre-mixed burners, and do not condense moisture from the flue gases
EN 777-1:2009 – Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use – Part 1: System D – Safety	
EN 777-2:2009 – Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use – Part 2: System E – Safety	
EN 777-3:2009 – Multi-burner gas-fired overhead radiant tube heater systems for non domestic use – Part 3: System F – Safety	
EN 777-4:2009 – Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use – Part 4: System H – Safety	
EN 621:2009 – Non-domestic gas-fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW, without a fan to assist transportation of combustion air and/or combustion products	Appliances with net heat input up to 300 kW with one or more atmospheric burners, and without a fan to assist the transportation of combustion air and/or flue gases
EN 1020:2009 – Non-domestic forced convection gas-fired air heaters for space heating not exceeding a net heat input of 300 kW incorporating a fan to assist transportation of combustion air or combustion products	Appliances with net heat input up to 300 kW with a fan to assist the transportation of combustion air and/or flue gases

Compliance – Performance

Compliance with performance requirements of relevant regulations is not mandatory for this Work Package. However, manufacturers are encouraged to aim to achieve this if possible.

The applicable ecodesign regulations for this lot are:

- Regulation 2015/1188 (which includes radiant heaters with nominal heat outputs of up to 120kW per product or product segment)

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- Regulation 2016/2281

In addition, some relevant standards are harmonised under the CPR.

For reference the relevant performance thresholds for NO_x emission and efficiency have been extracted and are presented below.

NO_x Emissions

Thresholds set in ecodesign regulations are summarised in the following table

Regulation	2015/1188 Luminous local space heaters and tube local space heaters	2016/2281 Warm air heaters using gaseous fuels	
Date in force	From 1 st January 2018	From 26 th September 2018	From 1 st January 2021
Maximum NO _x emission mg/kWh input based on GCV	200	100	70

The NO_x emission thresholds set in CPR standards are summarised in this table.

Standards	EN 1020:2009	EN 416-1:2009, EN 777-1:2009, EN 777-2:2009, EN 777-3:2009, EN 777-4:2009	EN 621:2009, EN 778:2009, EN 1319:2009
Weighted NO _x emission classes	Maximum NO _x concentration mg/kWh		
1	260	260	260
2	200	200	
3	150	150	
4	100	100	
5	50		

The NO_x emission performance as measured above will be published.

Efficiency

Efficiency shall be measured using the method described in the relevant product standards.

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Thresholds set in ecodesign regulations are summarised in the following table

Regulation	2015/1188		2016/2281	
Seasonal space heating energy efficiency, %, from	Luminous local space heaters	Tube local space heaters	B1 warm air heaters with a rated heat output below 10 kW and C2 and C4 warm air heaters with a rated heat output below 15 kW	Other Warm air heaters using fuels
1 st January 2018	85	74	68	72
1 st January 2021				78

The efficiency thresholds set in CPR standards are:

EN 621:2009, EN 1020:2009, EN 778:2009, EN 1319:2009

Minimum net efficiency at nominal heat input 84%

Minimum net efficiency at minimum rate 79%

For radiant heaters, although not harmonised under CPR, EN 416-2:2009 sets class thresholds for 'Rational use of energy – radiant factor for appliances mounted horizontally' as follows:

Class	Radiant Factor
1	>0.4 to <=0.5
2	>0.5

The efficiency performance as measured above will be published.

Function Specification – Lot 3 Wet, space heating

Two lots are sought: Lot 3A Burner integrated with a shell boiler (>400kW) and Lot 3B Boiler cascade controllers. The likely main use will be for distribution of heat through space heating systems. However, other closed water loop uses, such as the indirect production of sanitary hot water are not excluded. Independent gas fired direct water heaters are however not included in the scope of this ITT.

It is considered important that these lots do not overlap in either scale or design concept with the domestic products already sought under Hy4Heat Work Package 4. Lot 3 is therefore specific in its requirements.

Boiler Systems:

Lot 3A Burner integrated with a shell boiler

Packaged boilers of higher outputs (>400kW) are used in the commercial sector. These comprise a boiler body, and a forced draft burner brought together at the producer's assembly facility, (in contrast to the burner integration approach typically adopted for domestic boilers) the whole being designed and marketed as a complete boiler. Such products should be within the scope of EN 303-7 (Heating Boilers – Gas-fired central heating boilers equipped with a forced draught burner of nominal heat output not exceeding 1000 kW) with burners to EN 676 (Automatic forced draught burners for gaseous fuels).

In principle the key impact of a conversion to hydrogen for such appliances is on the burner and its control system. If hydrogen packaged burners are developed which provide heat release rates and patterns comparable with those for an equivalently rated burner fired with natural gas, then potentially, appropriately specified existing boiler bodies could be matched with them to provide overall packages. The product can only be developed as single burner/boiler combination to be marketed as a complete product.

Compliance – Safety and Function

GAR

The delivered product (Lot 3A) must be demonstrated to comply with the essential requirements of the GAR by undertaking type testing and on-going certification by a suitably approved Notified Body. Manufacturers are expected to determine the appropriate standards and testing procedures, working with their Notified Body as necessary. Hy4Heat's Work Package 3 is currently looking to develop information to assist this process.

It is required that certificates issued during the development of appliances under this Work Package (commercial hydrogen appliances) are (as a minimum) of sufficient duration to cover the duration of the unoccupied demonstration trail. It is accepted these may be location limited.

Compliance – Performance

Compliance with performance requirements is not mandatory for this Work Package. However, manufacturers are encouraged to aim to achieve this if possible.

Efficiency

Appliances for this ITT that fall within the scope of ecodesign regulations include cascades of boilers less than 400kW. The target performance is as specified in the relevant regulation.

Requirements for seasonal space heating efficiency are (EU 813/2013)¹⁷:

Fuel boiler space heaters with rated heat output ≤ 70 kW and fuel boiler combination heaters with rated heat output ≤ 70 kW,

The seasonal space heating energy efficiency shall not fall below 86% (Gross or HHV basis)

Fuel boiler space heaters with rated heat output > 70 kW and ≤ 400 kW and fuel boiler combination heaters with rated heat output > 70 kW and ≤ 400 kW:

The useful efficiency at 100% of the rated heat output shall not fall below 86%, and the useful efficiency at 30% of the rated heat output shall not fall below 94% (Gross or HHV basis)

Packaged boilers above 400kW are not covered by ecodesign regulations. The applicable standards for this lot includes:

EN 303-7 Heating boilers — Part 7: Gas-fired central heating boilers equipped with a forced draught burner of nominal heat output not exceeding 1 000 kW

For boilers rated from 400 kW to 1000 kW rational use of energy performance thresholds are:

Efficiency, %	standard boilers	low temperature boilers
At maximum nominal heat input	≥ 89.2	≥ 91.4
At part load	≥ 87.8	≥ 91.4

NOx Emissions

Appliances for this ITT that fall within the scope of ecodesign regulations include cascades of boilers less than 400kW. The target performance for these technologies are as specified in the relevant regulation. Otherwise any limits specified in the relevant technical standards shall be considered

Requirements for NOx emission are (EU 813/2013):

Emissions of nitrogen oxides, expressed in nitrogen dioxide, of heaters shall not exceed the following values:

Fuel boiler space heaters using gaseous fuels: 56 mg/kWh fuel input in terms of GCV

Packaged boilers above 400kW are not covered by ecodesign regulations. The applicable standards for this lot includes:

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EN 303-7 Heating boilers — Part 7: Gas-fired central heating boilers equipped with a forced draught burner of nominal heat output not exceeding 1 000 kW

For boilers rated from 400 kW to 1,000kW NOx classes are defined and contractors will be expected to seek to attain the highest possible class:

NOx Classes	Limit NOx concentration (mg/kWh)
1	170
2	120
3	80

The NOx emission performance as measured above will be published.

Lot 3B Boiler cascade controllers to satisfy heat loads up to 400kW

Boiler cascades comprise groups of boilers, (generally all of them having the same rated capacity), with overall controls that determine which of the boilers runs and at what output level. At this stage this is an option for providing wet heating capacity at scales needed for many small commercial activities. Cascades of natural gas boilers already exist as products. Cascade controls for groups of such boilers would need to accommodate the hydrogen specific firing strategies that they incorporate. The cascade controller shall provide a route to providing up to 400kW of heat output with good responsive control and high efficiencies.

Bids are sought from BOTH manufacturers developing product under HyHeat WP4 AND any other manufacturers having domestic scale hydrogen boilers. For these other manufacturers their hydrogen boilers must be demonstrable as meeting the safety and function requirements to be met by boilers developed under Hy4Heat WP4. It is thought unlikely that an organisation other than an OEM of hydrogen boilers will have sufficient understanding of the operation of these products to submit a successful bid.

Function Specification – Lot 4 Combined Heat & Power for commercial premises

Combined Heat and Power (CHP) refers to the simultaneous generation in one process of thermal energy and electrical or mechanical energy (Energy Efficiency Directive 2012/27/EU, EED).

CHP units with thermal ratings below 400kW and electrical ratings below 50 kW (micro CHP (mCHP) according to the EED) fall within the scope of the Ecodesign regulation 813/2013.

BS EN 50465:2015 European product standard for combined heating power systems using gas fuel is harmonised under Regulation 813/2013.

Essentially a 'like for like' product is sought except that it must be heat led and optimised for heat production, further details are provided below:

- Fuel cell mCHP. The fuel cell assembly itself will already be proven consuming hydrogen. This product could currently be operated in power only mode. The fuel cell could be part of an existing natural gas fired product containing an on-board reformer. Lot 4 will seek the repacking of this fuel cell into a product suitable for commercial applications.
- Stirling engine mCHP. The Stirling engine will already be well proven consuming a range of gases. Lot 4 will seek the repackaging of this into a product suitable for the commercial market.
- Internal combustion engine mCHP. This IC engine will be well proven consuming a range of gases. Lot 4 will seek the repackaging of this into a product suitable for the commercial market.

The scope of this ITT is for mCHP that fall within the scope of Regulation 813/2013. The appliance shall have a prime mover of one of the types defined in BS EN 50465:2015, as stated above.

Manufacturers and products already under contract Hy4Heat WP4 (Domestic products) are excluded from bidding.

Compliance – Safety and Function

GAR

The delivered product must be demonstrated to comply with the essential requirements of the GAR by undertaking type testing and on-going certification by a suitably approved Notified Body. Manufacturers are expected to determine the appropriate standards and testing procedures, working with their Notified Body as necessary. Hy4Heat's Work Package 3 is currently looking to develop information to assist this process.

It is required that certificates issued during the development of appliances under this Work Package (commercial hydrogen appliances) are (as a minimum) of sufficient duration to cover the duration of the unoccupied demonstration trail. It is accepted these may be location limited.

Compliance – Performance

Compliance with performance requirements is not mandatory for this Work Package. However, manufacturers are encouraged to aim to achieve this if possible.

Efficiency

Appliances for this ITT that fall within the scope of ecodesign regulations include mCHP space heaters. The target performance for these technologies are as specified in the relevant regulation.

Requirements for seasonal space heating efficiency are (EU 813/2013)¹⁷: CHP space heaters: **The seasonal space heating energy efficiency shall not fall below 100%**

CHP space heaters: **The seasonal space heating energy efficiency shall not fall below 100%**

The efficiency performance as measured above will be published.

NOx Emissions

Appliances for this ITT that fall within the scope of ecodesign regulations include mCHP space heaters. The target performance for these technologies are as specified in the relevant regulation. Otherwise any limits specified in the relevant technical standards shall be considered

Requirements for NOx emission are (EU 813/2013):

Emissions of nitrogen oxides, expressed in nitrogen dioxide, of heaters shall not exceed the following values:

CHP space heaters:

CHP space heaters equipped with external combustion using gaseous fuels: 70 mg/kWh fuel input in terms of GCV. This is class 5 as defined in BS EN 50465:2015

CHP space heaters equipped with an internal combustion engine using gaseous fuels: 240 mg/kWh fuel input in terms of GCV. This is somewhat better than class 1 as defined in BS EN 50465:2015

The NOx emission performance as measured above will be published.

Specification – Lot 5 Components

It is anticipated that for this programme a range of components will be procured such as to enable installation of hydrogen appliances for the following scenarios:

- a dwelling relying on gas for; heating of spaces, provision of sanitary hot water and cooking of food
- a commercial premises using gas appliances of the types within the scope of this ITT.

These components must enable safe connections to be made from appliance isolation valve, up to and including the emergency control valve (ECV). They will include; pipes, hoses, fittings and valves. These fall within the definition provided in the GS(I&U)R 1998, Regulation 2(1) of “gas fittings” which means gas pipework, valves, regulators and meters, and fittings, apparatus and appliances designed for use by consumers of gas for heating, lighting, cooking or other purposes for which gas can be used. To avoid confusion, these are not fittings as might be classified under the GAR.

Products offered are expected to include:

Piping (including connecting hoses and metal pipe)

- Pipe fittings (for connecting pipes)
- Gas valves
- Gas pressure regulators
- Emergency control valves (ECV)

A full list can be seen within the catalogue of almost any good gas fitting supplier.

The requirements ECVs are specific:

- Emergency control valves currently used in the GB LP gas networks will have been confirmed to be suitable for use with natural gas. For this tender specific confirmation is required of performance with gas comprising mainly hydrogen, i.e. 98% or more.

For this tender specific confirmation is required of performance with gas comprising mainly hydrogen, i.e. >98%

For the avoidance of doubt BEIS may decide not to proceed with the requirement for the device for use within PE pipe if this is procured through other parts of the UK hydrogen programme.

GS(I&U)R 1998, Regulation 5(1) requires that installers must not install a gas fitting unless every part of it is of good construction and sound material, of adequate strength and size to secure safety and of a type appropriate for the gas with which it is to be used. In the case of this ITT the gas is hydrogen as specified in this Annex under the heading ‘Information for all products’

GS(I&U)R 1998, Regulation 2(1) defines an “appropriate fitting” as a fitting which:

- a) has been designed for the purpose of effecting a gas tight seal in a pipe or other gasway;
- b) achieves that purpose when fitted; and

- c) is secure, so far as is reasonably practicable, against unauthorised opening or removal;

The joint types that they are used to create must be suitable for the containment of hydrogen at pressures in the range specified in this Annex under the heading 'Information for all products'.

It is unlikely that individual manufacturers would produce the full range of components needed. It is expected that gas component wholesalers/merchants or trade organisations (potentially assisted by consultants) will be more suitably positioned to engage with suppliers to deliver such components. This does not preclude any manufacturer with a sufficiently broad product range from tendering for this project.

The bid document should include a list of key components expected to be required for the installation of hydrogen appliances in the scenarios specified including the ECV. This will be the basis of procurement of components during the remainder of the project. The list will need to be compiled based on the contractor's knowledge of and experience with the market for these products.

This list will be agreed with BEIS and the Hy4Heat team as part of the contracting process. This will include identification of each item that is to be procured.

The work will include the provision of a physical example of each of the products identified. These must have been determined to be suitable for use with hydrogen as specified in this annex. Each component must be supported by a certificate/declaration from the OEM with regards to its performance with hydrogen of the quality specified in this Annex at the operating declared by the manufacturer. The evidence of performance is not prescribed in this ITT.

Where components fall within the scope of the Construction Products Regulation (CPR) the procedures for demonstrating CPR compliance should be followed but with adjustments for hydrogen.

Where components fall within the scope of the Construction Products Regulation (CPR) the procedures for demonstrating CPR compliance should be followed but with adjustments for hydrogen.

For reference the standards harmonised under the CPR which explicitly relate to gas components are:

- EN 331:1998/A1:2010 - EN 331:1998/A1:2010 Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings
- EN 682:2002/A1:2005 - EN 682:2002/A1:2005 Elastomeric Seals - Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids
- EN 969:2009 - Ductile iron pipes, fittings, accessories and their joints for gas pipelines - Requirements and test methods
- EN 1057:2006+A1:2010 - Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications
- EN 14800:2007 - EN 14800:2007 - Corrugated safety metal hose assemblies for the connection of domestic appliances using gaseous fuels
- EN 15069:2008 - Safety gas connection valves for metal hose assemblies used for the connection of domestic appliances using gaseous fuel

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Other components need to be demonstrated to conform to the requirements of the appropriate British, European or International standard with suitable adjustments for hydrogen as necessary.

The ENA publish a range of Gas Industry Standards. Mainly these relate to components used in networks but some of them may be useful reference points for components being procured through this ITT.

Depending on the requirements, in some instances (some simple components) extensive and demonstrable field evidence of good performance may suffice. In others some supporting work including 3rd party product testing may be required.

Annex 3: Eligible and Ineligible Costs

Eligible Costs

Directly incurred costs:

These are costs that are specific to the project that will be charged to the project as the amount spent, fully supported by an audit record justification of a claim. They comprise:

Labour costs for all those contributing to the project broken down by individual

Material costs (including consumables specific to the project)

Capital equipment costs (cost or depreciation as appropriate)

Decommissioning costs

Sub-contract costs

Travel and subsistence

Indirect costs:

Indirect costs should be charged in proportion to the amount of effort deployed on the project. Applicants should calculate them, using their own cost rates. They include:

General office and basic laboratory consumables

Library services / learning resources

Administrative / secretarial

Finance, personnel, public relations and departmental services

Central and distributed computing

Cost of capital employed

Overheads

Ineligible Costs

Under no circumstances can costs for the following items be claimed:

Commercialisation activities

Protection of IPR

For activities of a political or exclusively religious nature;

In respect of costs reimbursed or to be reimbursed by funding from other public authorities or from the private sector;

In connection with the receipt of contributions in kind (a contribution in goods or services as opposed to money);

To cover interest payments (including service charge payments for finance leases);

For the giving of gifts to individuals;

For entertaining (entertaining for this purpose means anything that would be a taxable benefit to the person being entertained, according to UK tax regulations);

To pay statutory fines, criminal fines or penalties; or

In respect of VAT that you are able to claim from HM Revenue and Customs.

Annex 4: Terms and Conditions

See separate document.

Annex 5: Application Form

(included as separate document)

Department of Business, Energy and Industrial Strategy

SBRI Commercial Hydrogen Appliance, Boiler Cascade, and
Ancillary Component Development Competition (Hy4Heat -
Work Package 5b)

TRN: 1996/07/2019

Application Form

Closing Date: Friday 13 September 2019, 12 Noon

Lead applicant:

Project name:

Lot / Sub-lot (including lot/sub-lot description):

Date:

Contact for enquiries

Department of Business, Energy and Industrial Strategy (BEIS)

Email: builtenvironmentinnovation@beis.gov.uk

Possible disclosure of information provided in response to this Competition

The Freedom of Information Act 2000 ("FOIA") and the Environmental Information Regulations 2004 ("EIR") apply to the Department. You should be aware of the Department's obligations and responsibilities under FOIA or EIR to disclose, on written request, recorded information held by the Department.

Information provided in connection with this procurement exercise, or with any contract that may be awarded as a result of this exercise, may therefore have to be disclosed by the Department in response to such a request, unless the Department decides that one of the statutory exemptions under the FOIA or the exceptions in the EIR applies.

If you wish to designate information supplied as part of this response as confidential, or if you believe that its disclosure would be prejudicial to any person's commercial interests, you must provide clear and specific detail as to the precise information involved and explain (in broad terms) what harm may result from disclosure if a request is received, and the time period applicable to that sensitivity. Such designation alone may not prevent disclosure if in the Department's reasonable opinion publication is required by applicable legislation or Government policy or where disclosure is required by the Information Commissioner or the First-tier Tribunal (Information Rights).

Additionally, the Government's transparency agenda requires that tender documents (including ITTs such as this) are published on a designated, publicly searchable web site. The same applies to other tender documents issued by the Department (including the original advertisement and the pre-qualification questionnaire (if used)), and any contract entered into by the Department with its preferred supplier once the procurement is complete.

By submitting a tender you agree that your participation in this procurement may be made public. The answers you give in this response will not be published on the transparency web site (but may fall to be disclosed under FOIA or EIR (see above)).

Where tender documents issued by the Department or contracts with its suppliers fall to be disclosed the Department will redact them as it thinks necessary, having regard (inter alia) to the exemptions/exceptions in the FOIA or EIR.

Non-Collusion

No tender will be considered for acceptance if the contractor has indulged or attempted to indulge in any corrupt practice or canvassed the tender with an officer of the Department. Declaration 1 contains a "Statement of non-collusion"; any breach of the undertakings covered under items 1 - 3 inclusive will invalidate your tender.

If a contractor has indulged or attempted to indulge in such practices and the tender is accepted, then grounds shall exist for the termination of the contract and the claiming damages from the successful contractors.

You must not:

Tell anyone else what your tender price is or will be, before the time limit for delivery of tenders.

Try to obtain any information about anyone else's tender or proposed tender before the time limit for delivery of tenders.

Make any arrangements with another organisation about whether or not they should tender, or about their or your tender price.

Offering an inducement of any kind in relation to obtaining this or any other contract with the Department will disqualify your tender from being considered and may constitute a criminal offence.

Application Guidance

Applicants are urged to read all sections of this ITT carefully before completing this form and are asked to ensure that they provide sufficient information to demonstrate compliance with the Eligibility Criteria and the Evaluation Criteria.

Applicants are encouraged to write self-contained responses, using the guidance provided to limit the size of the application. Applicants may annex additional material if it is relevant to the evaluation criteria and materially strengthens the application. Applicants are requested to maintain the structure of the application form.

Applications should detail plans across all phases of the Competition.

This application has the following sections:

- A. Application Form: Summary Information**
- B. Application Form: Proposal Details**
- C. Declarations**

A. Application Form: Summary Information

Summary Information	
Project Name	
Lot (delete as appropriate)	Lot 1: Catering & Production Heating Lot 2: Dry Space Heating Lot 3: Wet Space Heating Lot 4: Combined Heat and Power Lot 5: Ancillary System Components
Sub-lot (delete as appropriate)	Lot 1A: ≤15 kW Lot 1B: 15-30 kW Lot 1C: ≥30 kW Lot 2A: ≤50 kW Lot 2B: 50-120 kW Lot 3A: Burner integrated with a shell boiler (>400 kW) Lot 3B: Control for a boiler cascade (<400 kW) Lot 4: N/A Lot 5: N/A
Appliance Type (delete as appropriate) (Only applicable to Lot 1, 2, 3A and 4)	a) Hydrogen only b) Dual Fuel c) Hydrogen ready d) Adaptable
Appliance requirements achieved (delete as appropriate) (Only applicable to Lot 1, 2, 3A and 4)	a) Core b) Core+
Project Summary	Please provide a brief summary of your proposed project, clearly demonstrating that the proposal is in scope, and the key outputs of the project will be achieved.
List of Annexes	
Contract Duration	
Proposed Start Date	

Application form continues on the next page

**SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component
Development Competition (TRN: 1996/07/2019)**

Lead applicant details	
Registered name	
Registered address	
Company registration No.	
VAT registration No.	
Country	
Region	
No. of employees	
Main activity	
Business sector	
Organisation type	
Website	
Lead contact details	
Name	
Position	
Organisation	
Correspondence address	
Telephone	
Email	

Application form continues on the next page

B. Application Form: Proposal Details

Please note that items B1, B2 and B3 must be a maximum of 15 A4 pages, Arial font minimum size 12pt with single spacing and minimum 2.5cm margins.

B1. Skills and Expertise - Applicable to all lots

Total score 20
a. Evidence that the team has relevant skills and expertise to undertake the project, including demonstrating capability of working with hydrogen and/or town gas <i>(weighting x 2);</i> b. Details of project team including organisational structure. If your bid is a consortium, this should clearly state the consortium lead and details of each consortium member and their role <i>(weighting x 1);</i> c. Evidence of appropriate facilities (either existing or planned) that are required to undertake the project <i>(weighting x 1).</i>

Application form continues on the next page

B2i. Technical Approach: Appliance development (Lot 1, 2, 3A and 4)

Total score 35

- a. Provide a clear description of the proposed hydrogen appliance. Describe the approach and methodologies that will be applied to address the challenges defined in the ITT and any others which may be considered relevant

(weighting x 2);

- b. Provide justification for the development of the proposed appliance and how this meets the requirements set out in the ITT, specifically Section 1.3 objectives. Where a reference appliance is applicable this should be based on sales, market share and future market trends. This should include:

1. Photo/picture of base line reference appliance
2. Technical specification
3. Installation instructions
4. User instructions

(Installation and user instructions may be provided as appendices)

(weighting x 2);

- c. Demonstrate how your proposal provides further value by developing 'dual fuel', 'hydrogen ready' or 'adaptable' variants to simplify the switch-over process or transition to hydrogen

(weighting x 2);

- d. Include evidence that you understand the risks associated with hydrogen use and, in comparison to natural gas include reference to risks outlined in Section 10.1

(weighting x 1).

NB – only text written within the page limit will be assessed and marked.

Documents may be referenced, and detail included in an appendix to provide supporting evidence to an answer. Please note that the appendix documents themselves will not be assessed. Those documents may include:

- Standard documents for reference appliance technical specification (Q.2b)
- Standard documents for reference appliance installation instructions (Q.2b)
- Letters of support or Memorandum of Understanding (MOU) (Q.2d)

Appendix documents are excluded from the page limit.

B2ii. Technical Approach: Boiler Cascade (Lot 3B)

Total score 35

- a. Provide a clear description of the proposed boiler system and boiler into which it will be integrated, highlighting its suitability. Describe the approach and methodologies that will be applied to address the challenges defined in the ITT and any others which may be considered relevant

(weighting x 2);

- b. Provide justification for the development of the proposed boiler system and how this meets the requirements set out in the ITT, specifically Section 1.3 objectives. Where a reference appliance is applicable this should be based on sales, market share and future market trends. This should include:

- Photo/picture of base line reference appliance
- Technical specification
- Installation instructions
- User instructions

(Installation and user instructions may be provided as appendices)

(weighting x 2);

- c. Demonstrate how your proposal provides further value by developing 'dual fuel', 'hydrogen ready' or 'adaptable' variants to simplify the switch-over process or transition to hydrogen

(weighting x 2);

- d. Include evidence that you understand the risks associated with hydrogen use and, in comparison to natural gas include reference to risks outlined in Section 10.1

(weighting x 1).

NB – only text written within the page limit will be assessed and marked.

Documents may be referenced, and detail included in an appendix to provide supporting evidence to an answer. Please note that the appendix documents themselves will not be assessed. Those documents may include:

- Standard documents for reference appliance technical specification (Q.2b)
- Standard documents for reference appliance installation instructions (Q.2b)
- Letters of support or Memorandum of Understanding (MOU) (Q.2d)

Appendix documents are excluded from the page limit.

B2iii. Technical Approach: Components Development (Lot 5)

Total score 35

- a. Provide a clear and comprehensive list of the ancillary components which are required for the installation of hydrogen appliances that the supplier can deliver.

Justify development of the proposed set of components based on sales, market share and future market trends of equivalent natural gas components. This should include:

- Lists of base line components
- Technical specifications
- Installation instructions
- User Instructions
- Recommended retail price

(weighting x 4);

- b. Describe the approach and methodologies that will be applied to address the challenges defined in the ITT, specifically Section 1.3 objectives. and any others which may be considered relevant

(weighting x 2);

- c. Include evidence that you understand the risks associated with hydrogen use and, in comparison to natural gas include reference to risks outlined in Section 10.1.

(weighting x 1).

NB – only text written within the page limit will be assessed and marked.

Documents may be referenced, and detail included in an appendix to provide supporting evidence to an answer. Please note that the appendix documents themselves will not be assessed. Those documents may include:

- *Standard documents for reference appliance technical specification (Q.2b)*
- *Standard documents for reference appliance installation instructions (Q.2b)*
- *Letters of support or Memorandum of Understanding (MOU) (Q.2d)*

Appendix documents are excluded from the page limit.

B3. Management of Delivery / Project Plan – Applicable to all lots

Total score 20

- Detailed description of work and associated timelines to complete all milestones (include a Gantt chart)
(weighting x 1);
- Description of management plans to demonstrate how the project will be delivered alongside existing commitments. Include detail of your quality assurance procedures
(weighting x 1);
- Key risks relating to the delivery and dependencies of the project, including mitigation plans. Risks should be presented in the table provided in the application form and may include technical, user-related and safety aspects
(weighting x 2).

Risks:

This table can be presented outside this box section and in landscape orientation if required.

Ref	Risk description	Likelihood (H/M/L)	Impact (H/M/L)	Mitigation

B4. Cost (see separate document for application) – Applicable to all lots

Total score 25	Page limit n/a (i.e. not included in 15-page total)
Bid cost for project (<i>weighting x 5</i>). Cost of projects should be provided for either: • Lots 1, 2, 3A or 4 - Meeting the core requirement OR • Lots 1, 2, 3A or 4 – Meeting the core+ requirement OR • Lot 3B - Milestones 1 through to 3 for boiler cascade OR • Lot 5 - Milestones 1 through to 3 for ancillary system component development. Price will be marked proportionately to the lowest bid within each lot/sub-lot that is meeting the same requirements (i.e. core or core+ for appliance development). The lowest bid will receive maximum marks for the price element and then all other bids' prices will be marked proportionately to that bid. Applicants submitting bids for more than one project must indicate what discount they are prepared to offer on their costs if they are awarded more than one project to take account of any duplicated work in their multiple proposals. Any discount will not form part of the assessment of the cost but will be applied to the signed contracts. Applicants should clearly state where cost savings are being provided compared to exclusive development contracts.	
For Pricing Schedule, see separate document.	

Scoring Method

Each question will be scored from one to five. The following illustrates the meaning of each score:

Score	Description
1	Not Satisfactory: Proposal contains significant shortcomings and does not meet the required standard
2	Partially Satisfactory: Proposal partially meets the required standard, with one or more moderate weaknesses or gaps
3	Satisfactory: Proposal mostly meets the required standard, with one or more minor weaknesses or gaps.
4	Good: Proposal meets the required standard, with moderate levels of assurance
5	Excellent: Proposal fully meets the required standard with high levels of assurance

Section C: Declarations

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Declaration 1: Statement of Non-collusion

To: The Department of Business Energy and Industrial Strategy

1. We recognise that the essence of competitive tendering is that the Department will receive a bona fide competitive tender from all persons tendering. We therefore certify that this is a bona fide tender and that we have not fixed or adjusted the amount of the tender or our rates and prices included therein by or in accordance with any agreement or arrangement with any other person.
2. We also certify that we have not done and undertake not to do at any time before the hour and date specified for the return of this tender any of the following acts:
 - (a) communicate to any person other than the Department the amount or approximate amount of our proposed tender, except where the disclosure, in confidence, of the approximate amount is necessary to obtain any insurance premium quotation required for the preparation of the tender;
 - (b) enter into any agreement or arrangement with any other person that he shall refrain from submitting a tender or as to the amount included in the tender;
 - (c) offer or pay or give or agree to pay or give any sum of money, inducement or valuable consideration directly or indirectly to any person doing or having done or causing or having caused to be done, in relation to any other actual or proposed tender for the contract any act, omission or thing of the kind described above.
3. In this certificate, the word "person" shall include any person, body or association, corporate or unincorporated; and "any agreement or arrangement" includes any such information, formal or informal, whether legally binding or not.

.....
Signature (duly authorised on behalf of the tenderer)

.....
Print name

.....
On behalf of (organisation name)

.....
Date

Declaration 2: Form of Tender

To: The Department of Business, Energy and Industrial Strategy

- Having considered the invitation to tender and all accompanying documents
- (including without limitation, the terms and conditions of contract and the Specification) we confirm that we are fully satisfied as to our experience and ability to deliver the goods/services in all respects in accordance with the requirements of this invitation to tender.
- We hereby tender and undertake to provide and complete all the services required to be performed in accordance with the terms and conditions of contract and the Specification for the amount set out in the Pricing Schedule.
- We agree that any insertion by us of any conditions qualifying this tender or any unauthorised alteration to any of the terms and conditions of contract made by us may result in the rejection of this tender. We agree that this tender shall remain open to be accepted by the Department for 8 weeks from the date below.
- We understand that if we are a subsidiary (within the meaning of section 1159 of (and schedule 6 to) the Companies Act 2006) if requested by the Department we may be required to secure a Deed of Guarantee in favour of the Department from our holding company or ultimate holding company, as determined by the Department in their discretion.
- We understand that the Department is not bound to accept the lowest or any tender it may receive.
- We certify that this is a bona fide tender.

.....
Signature (duly authorised on behalf of the tenderer)

.....
Print name

.....
On behalf of (organisation name)

.....
Date

Declaration 3: Conflict of Interest

I have nothing to declare with respect to any current or potential interest or conflict in relation to this research (or any potential providers who may be subcontracted to deliver this work, their advisers or other related parties). By conflict of interest, I mean, anything which could be reasonably perceived to affect the impartiality of this research, or to indicate a professional or personal interest in the outcomes from this research.

Signed

Name

Position

OR

I wish to declare the following with respect to personal or professional interests related to relevant organisations*;

X

X

Where a potential conflict of interest has been declared for an individual or organisation within a consortium, please clearly outline the role which this individual or organisation will play in the proposed project and how any conflict of interest has or will be mitigated.

X

X

Signed

Name

Position

Please complete this form and return this with your application form - Nil returns **are** required.

*These may include (but are not restricted to);

A professional or personal interest in the outcome of this research

For evaluation projects, a close working, governance, or commercial involvement in the project under evaluation

Current or past employment with relevant organisations

**SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component
Development Competition (TRN: 1996/07/2019)**

Payment (cash or other) received or likely to be received from relevant organisations for goods or services provided (Including consulting or advisory fees)

Gifts or entertainment received from relevant organisation

Shareholdings (excluding those within unit trusts, pension funds etc.) in relevant organisations

Close personal relationship or friendships with individuals employed by or otherwise closely associated with relevant organisations

All of the above apply both to the individual signing this form and their close family / friends / partners etc.

If your situation changes during the project in terms of interests or conflicts, you must notify BEIS straight away.

A DECLARATION OF INTEREST WILL NOT NECESSARILY MEAN THE INDIVIDUAL OR ORGANISATION CANNOT WORK ON THE PROJECT; BUT IT IS VITAL THAT ANY INTEREST OR CONFLICT IS DECLARED SO IT CAN BE CONSIDERED OPENLY.

Declaration 4: Standard Selection Questionnaire

Potential Supplier Information and Exclusion Grounds: Part 1 and Part 2.

The standard Selection Questionnaire is a self-declaration, made by you (the potential supplier), that you do not meet any of the grounds for exclusion¹⁸. If there are grounds for exclusion, there is an opportunity to explain the background and any measures you have taken to rectify the situation (we call this self-cleaning).

A completed declaration of Part 1 and Part 2 provides a formal statement that the organisation making the declaration has not breached any of the exclusions grounds. Consequently we require all the organisations that you will rely on to meet the selection criteria to provide a completed Part 1 and Part 2. For example these could be parent companies, affiliates, associates, or essential sub-contractors, if they are relied upon to meet the selection criteria. This means that where you are joining in a group of organisations, including joint ventures and partnerships, each organisation in that group must complete one of these self-declarations. Sub-contractors that you rely on to meet the selection criteria must also complete a self-declaration (although sub-contractors that are not relied upon do not need to complete the self-declaration).

When completed, this form is to be sent back to the contact point given in the procurement documents along with the selection information requested in the procurement documentation.

Alternatively you can submit the completed Exclusion Grounds of the [EU ESPD \(Part III\)](#) as a downloaded XML file to the buyer contact point along with the selection information requested in the procurement documentation.

Supplier Selection Questions: Part 3

The procurement document will provide instructions on the selection questions you need to respond to and how to submit those responses. If you are bidding on behalf of a group (consortium) or you intend to use sub-contractors, you should complete all of the selection questions on behalf of the consortium and/or any sub-contractors.

If the relevant documentary evidence referred to in the Selection Questionnaire is not provided upon request and without delay we reserve the right to amend the contract award decision and award to the next compliant bidder.

Consequences of misrepresentation

If you seriously misrepresent any factual information in filling in the Selection Questionnaire, and so induce an authority to enter into a contract, there may be significant consequences. You may be excluded from the procurement procedure, and from bidding for other contracts for three years. If a contract has been entered into you may be sued for damages and the contract may be rescinded. If fraud, or fraudulent intent, can be proved, you or your responsible officers may be prosecuted and convicted of the offence of fraud by false representation, and you must be excluded from further procurements for five years.

¹⁸ For the list of exclusion please see
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/551130/List_of_Mandatory_and_Disccretionary_Exclusions.pdf

**SBRI Commercial Hydrogen Appliance, Boiler Cascade, and
Ancillary Component Development Competition**

(Hy4Heat - Work Package 5b)

TRN: 1996/07/2019

Notes for completion

1. The “authority” means the contracting authority, or anyone acting on behalf of the contracting authority, that is seeking to invite suitable candidates to participate in this procurement process.
2. “You” / “Your” refers to the potential supplier completing this standard Selection Questionnaire i.e. the legal entity responsible for the information provided. The term “potential supplier” is intended to cover any economic operator as defined by the Public Contracts Regulations 2015 (referred to as the “regulations”) and could be a registered company; the lead contact for a group of economic operators; charitable organisation; Voluntary Community and Social Enterprise (VCSE); Special Purpose Vehicle; or other form of entity.
3. Please ensure that all questions are completed in full, and in the format requested. If the question does not apply to you, please state ‘N/A’. Should you need to provide additional information in response to the questions, please submit a clearly identified annex.
4. The authority recognises that arrangements set out in section 1.2 of the standard Selection Questionnaire, in relation to a group of economic operators (for example, a consortium) and/or use of sub-contractors, may be subject to change and will, therefore, not be finalised until a later date. The lead contact should notify the authority immediately of any change in the proposed arrangements and ensure a completed Part 1 and Part 2 is submitted for any new organisation relied on to meet the selection criteria. The authority will make a revised assessment of the submission based on the updated information.
5. For Part 1 and Part 2 every organisation that is being relied on to meet the selection must complete and submit the self-declaration.
6. All sub-contractors are required to complete Part 1 and Part 2¹⁹
7. For answers to Part 3 - If you are bidding on behalf of a group, for example, a consortium, or you intend to use sub-contractors, you should complete all of the questions on behalf of the consortium and/ or any sub-contractors, providing one composite response and declaration.

The authority confirms that it will keep confidential and will not disclose to any third parties any information obtained from a named customer contact, other than to the Cabinet Office and/or contracting authorities defined by the regulations, or pursuant to an order of the court or demand made by any competent authority or body where the authority is under a legal or regulatory obligation to make such a disclosure.

¹⁹ See PCR 2015 regulations 71 (8)-(9)

Part 1: Potential Supplier Information

Please answer the following questions in full. Note that every organisation that is being relied on to meet the selection must complete and submit the Part 1 and Part 2 self-declaration.

Section 1	Potential supplier information	
Question No.	Question	Response
1.1(a)	Full name of the potential supplier submitting the information	
1.1(b) – (i)	Registered office address (if applicable)	
1.1(b) – (ii)	Registered website address (if applicable)	
1.1(c)	Trading status a) public limited company b) limited company c) limited liability partnership d) other partnership e) sole trader f) third sector g) other (please specify your trading status)	
1.1(d)	Date of registration in country of origin	
1.1(e)	Company registration number (if applicable)	
1.1(f)	Charity registration number (if applicable)	
1.1(g)	Head office DUNS number (if applicable)	
1.1(h)	Registered VAT number	
1.1(i) - (i)	If applicable, is your organisation registered with the appropriate professional or trade register(s) in the member state where it is established?	Yes ☐ No ☐ N/A ☐
1.1(i) - (ii)	If you responded yes to 1.1(i) - (i), please provide the relevant details, including the registration number(s).	
1.1(j) - (i)	Is it a legal requirement in the state where you are established for you to possess a particular	Yes ☐

SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component Development Competition (TRN: 1996/07/2019)

	authorisation, or be a member of a particular organisation in order to provide the services specified in this procurement?	No ☐
1.1(j) - (ii)	If you responded yes to 1.1(j) - (i), please provide additional details of what is required and confirmation that you have complied with this.	
1.1(k)	Trading name(s) that will be used if successful in this procurement	
1.1(l)	Relevant classifications (state whether you fall within one of these, and if so which one) a) Voluntary Community Social Enterprise (VCSE) b) Sheltered Workshop c) Public service mutual	
1.1(m)	Are you a Small, Medium or Micro Enterprise (SME) ²⁰ ?	Yes ☐ No ☐
1.1(n)	Details of Persons of Significant Control (PSC), where appropriate: ²¹ - Name; - Date of birth; - Nationality; - Country, state or part of the UK where the PSC usually lives; - Service address; - The date he or she became a PSC in relation to the company (for existing companies the 6 April 2016 should be used); - Which conditions for being a PSC are met; - Over 25% up to (and including) 50%,	

²⁰ See EU definition of SME: <http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/>

²¹ UK companies, Societates European (SEs) and limited liability partnerships (LLPs) will be required to identify and record the people who own or control their company. Companies, SEs and LLPs will need to keep a PSC register, and must file the PSC information with the central public register at Companies House. [See PSC guidance.](#)

SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component Development Competition (TRN: 1996/07/2019)

	- More than 50% and less than 75%, - 75% or more. ²² (Please enter N/A if not applicable)	
1.1(o)	Details of immediate parent company: - Full name of the immediate parent company - Registered office address (if applicable) - Registration number (if applicable) - Head office DUNS number (if applicable) - Head office VAT number (if applicable) (Please enter N/A if not applicable)	
1.1(p)	Details of ultimate parent company: - Full name of the ultimate parent company - Registered office address (if applicable) - Registration number (if applicable) - Head office DUNS number (if applicable) - Head office VAT number (if applicable) (Please enter N/A if not applicable)	

Please note: A criminal record check for relevant convictions may be undertaken for the preferred suppliers and the persons of significant in control of them.

²² Central Government contracting authorities should use this information to have the PSC information for the preferred supplier checked before award.

**SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component
Development Competition (TRN: 1996/07/2019)**

Please provide the following information about your approach to this procurement:

Section 1		Bidding model																						
Question No.	Question	Response																						
1.2(a) - (i)	Are you bidding as the lead contact for a group of economic operators?	Yes ☐ No ☐ If yes, please provide details listed in questions 1.2(a) (ii), (a) (iii) and to 1.2(b) (i), (b) (ii), 1.3, Section 2 and 3. If no, and you are a supporting bidder please provide the name of your group at 1.2(a) (ii) for reference purposes, and complete 1.3, Section 2 and 3.																						
1.2(a) - (ii)	Name of group of economic operators (if applicable)																							
1.2(a) - (iii)	Proposed legal structure if the group of economic operators intends to form a named single legal entity prior to signing a contract, if awarded. If you do not propose to form a single legal entity, please explain the legal structure.																							
1.2(b) - (i)	Are you or, if applicable, the group of economic operators proposing to use sub-contractors?	Yes ☐ No ☐																						
1.2(b) - (ii)	If you responded yes to 1.2(b)-(i) please provide additional details for each sub-contractor in the following table: we may ask them to complete this form as well. <table border="1"> <tbody> <tr> <td>Name</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Registered address</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Trading status</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>						Name						Registered address						Trading status					
Name																								
Registered address																								
Trading status																								

**SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component
Development Competition (TRN: 1996/07/2019)**

	Company registration number					
	Head Office DUNS number (if applicable)					
	Registered VAT number					
	Type of organisation					
	SME (Yes/No)					
	The role each sub-contractor will take in providing the works and /or supplies e.g. key deliverables					
	The approximate % of contractual obligations assigned to each sub-contractor					

**SBRI Commercial Hydrogen Appliance, Boiler Cascade, and Ancillary System Component
Development Competition (TRN: 1996/07/2019)**

Contact details and declaration

I declare that to the best of my knowledge the answers submitted and information contained in this document are correct and accurate.

I declare that, upon request and without delay I will provide the certificates or documentary evidence referred to in this document.

I understand that the information will be used in the selection process to assess my organisation's suitability to be invited to participate further in this procurement.

I understand that the authority may reject this submission in its entirety if there is a failure to answer all the relevant questions fully, or if false/misleading information or content is provided in any section.

I am aware of the consequences of serious misrepresentation.

Section 1	Contact details and declaration	
Question No.	Question	Response
1.3(a)	Contact name	
1.3(b)	Name of organisation	
1.3(c)	Role in organisation	
1.3(d)	Phone number	
1.3(e)	E-mail address	
1.3(f)	Postal address	
1.3(g)	Signature (electronic is acceptable)	
1.3(h)	Date	

Part 2: Exclusion Grounds

Please answer the following questions in full. Note that every organisation that is being relied on to meet the selection must complete and submit the Part 1 and Part 2 self-declaration.

Section 2		Grounds for mandatory exclusion
Question No.	Question	Response
2.1(a)	Regulations 57(1) and (2) The detailed grounds for mandatory exclusion of an organisation are set out on this web page, which should be referred to before completing these questions. These are also included under Annex 7. Please indicate if, within the past five years you, your organisation or any other person who has powers of representation, decision or control in the organisation been convicted anywhere in the world of any of the offences within the summary below and listed on the webpage.	
	Participation in a criminal organisation.	Yes ☐ No ☐ If Yes please provide details at 2.1(b)
	Corruption.	Yes ☐ No ☐ If Yes please provide details at 2.1(b)
	Fraud.	Yes ☐ No ☐ If Yes please provide details at 2.1(b)
	Terrorist offences or offences linked to terrorist activities	Yes ☐ No ☐ If Yes please provide details at 2.1(b)
	Money laundering or terrorist financing	Yes ☐ No ☐ If Yes please provide details at 2.1(b)

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	Child labour and other forms of trafficking in human beings	Yes ☐ No ☐ If Yes please provide details at 2.1(b)
2.1(b)	If you have answered yes to question 2.1(a), please provide further details. Date of conviction, specify which of the grounds listed the conviction was for, and the reasons for conviction, Identity of who has been convicted If the relevant documentation is available electronically please provide the web address, issuing authority, precise reference of the documents.	
2.2	If you have answered Yes to any of the points above have measures been taken to demonstrate the reliability of the organisation despite the existence of a relevant ground for exclusion? (Self Cleaning)	Yes ☐ No ☐
2.3(a)	Regulation 57(3) Has it been established, for your organisation by a judicial or administrative decision having final and binding effect in accordance with the legal provisions of any part of the United Kingdom or the legal provisions of the country in which the organisation is established (if outside the UK), that the organisation is in breach of obligations related to the payment of tax or social security contributions?	Yes ☐ No ☐
2.3(b)	If you have answered yes to question 2.3(a), please provide further details. Please also confirm you have paid, or have entered into a binding arrangement with a view to paying, the outstanding sum including where applicable any accrued interest and/or fines.	

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Please Note: The authority reserves the right to use its discretion to exclude a potential supplier where it can demonstrate by any appropriate means that the potential supplier is in breach of its obligations relating to the non-payment of taxes or social security contributions.

Section 3		Grounds for discretionary exclusion
Question No.	Question	Response
3.1	Regulation 57 (8) The detailed grounds for discretionary exclusion of an organisation are set out on this web page, which should be referred to before completing these questions. These are also included under Annex 7. Please indicate if, within the past three years, anywhere in the world any of the following situations have applied to you, your organisation or any other person who has powers of representation, decision or control in the organisation.	
3.1(a)	Breach of environmental obligations?	Yes ☐ No ☐ If yes please provide details at 3.2
3.1 (b)	Breach of social obligations?	Yes ☐ No ☐ If yes please provide details at 3.2
3.1 (c)	Breach of labour law obligations?	Yes ☐ No ☐ If yes please provide details at 3.2
3.1(d)	Bankrupt or is the subject of insolvency or winding-up proceedings, where the organisation's assets are being administered by a liquidator or by the court, where it is in an arrangement with creditors, where its business activities are suspended or it is in any analogous situation arising from a similar procedure under the laws and regulations of any State?	Yes ☐ No ☐ If yes please provide details at 3.2

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3.1(e)	Guilty of grave professional misconduct?	Yes ☐ No ☐ If yes please provide details at 3.2
3.1(f)	Entered into agreements with other economic operators aimed at distorting competition?	Yes ☐ No ☐ If yes please provide details at 3.2
3.1(g)	Aware of any conflict of interest within the meaning of regulation 24 due to the participation in the procurement procedure?	Yes ☐ No ☐ If yes please provide details at 3.2
3.1(h)	Been involved in the preparation of the procurement procedure?	Yes ☐ No ☐ If yes please provide details at 3.2
3.1(i)	Shown significant or persistent deficiencies in the performance of a substantive requirement under a prior public contract, a prior contract with a contracting entity, or a prior concession contract, which led to early termination of that prior contract, damages or other comparable sanctions?	Yes ☐ No ☐ If yes please provide details at 3.2
3.1(j)	Please answer the following statements	
3.1(j) - (i)	The organisation is guilty of serious misrepresentation in supplying the information required for the verification of the absence of grounds for exclusion or the fulfilment of the selection criteria.	Yes ☐ No ☐ If Yes please provide details at 3.2
3.1(j) - (ii)	The organisation has withheld such information.	Yes ☐ No ☐ If Yes please provide details at 3.2

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3.1(j) –(iii)	The organisation is not able to submit supporting documents required under regulation 59 of the Public Contracts Regulations 2015.	Yes ☐ No ☐ If Yes please provide details at 3.2
3.1(j)-(iv)	The organisation has influenced the decision-making process of the contracting authority to obtain confidential information that may confer upon the organisation undue advantages in the procurement procedure, or to negligently provided misleading information that may have a material influence on decisions concerning exclusion, selection or award.	Yes ☐ No ☐ If Yes please provide details at 3.2
3.2	If you have answered Yes to any of the above, explain what measures been taken to demonstrate the reliability of the organisation despite the existence of a relevant ground for exclusion? (Self Cleaning)	

Part 3: Selection Questions²³

Section 4		
Economic and Financial Standing		
Question No.	Question	Response
4.1	Are you able to provide a copy of your audited accounts for the last two years, if requested? If no, can you provide one of the following: answer with Y/N in the relevant box.	Yes ☐ No ☐
	(a) A statement of the turnover, Profit and Loss Account/Income Statement, Balance Sheet/Statement of Financial Position and Statement of Cash Flow for the most recent year of trading for this organisation.	Yes ☐ No ☐
	(b) A statement of the cash flow forecast for the current year and a bank letter outlining the current cash and credit position.	Yes ☐ No ☐
	(c) Alternative means of demonstrating financial status if any of the above are not available (e.g. forecast of turnover for the current year and a statement of funding provided by the owners and/or the bank, charity accruals accounts or an alternative means of demonstrating financial status).	Yes ☐ No ☐
4.2	Where we have specified a minimum level of economic and financial standing and/ or a minimum financial threshold within the evaluation criteria for this procurement, please self-certify by answering 'Yes' or 'No' that you meet the requirements set out.	Yes ☐ No ☐

²³ [See Action Note 8/16 Updated Standard Selection Questionnaire](#)

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Section 5	If you have indicated in the Selection Questionnaire question 1.2 that you are part of a wider group, please provide further details below:	
Name of organisation		
Relationship to the Supplier completing these questions		
5.1	Are you able to provide parent company accounts if requested to at a later stage?	Yes ☐ No ☐
5.2	If yes, would the parent company be willing to provide a guarantee if necessary?	Yes ☐ No ☐
5.3	If no, would you be able to obtain a guarantee elsewhere (e.g. from a bank)?	Yes ☐ No ☐

Section 6	Technical and Professional Ability
6.1	Relevant experience and contract examples Please provide details of up to three contracts, in any combination from either the public or private sector; voluntary, charity or social enterprise (VCSE) that are relevant to our requirement. VCSEs may include samples of grant-funded work. Contracts for supplies or services should have been performed during the past three years. Works contracts may be from the past five years. The named contact provided should be able to provide written evidence to confirm the accuracy of the information provided below. Consortia bids should provide relevant examples of where the consortium has delivered similar requirements. If this is not possible (e.g. the consortium is newly formed or a Special Purpose Vehicle is to be created for this contract) then three separate examples should be provided between the principal member(s) of the proposed consortium or Special Purpose Vehicle (three examples are not required from each member). Where the Supplier is a Special Purpose Vehicle, or a managing agent not intending to be the main provider of the supplies or services, the information requested should be provided in respect of the main intended provider(s) or sub-contractor(s) who will deliver the contract. If you cannot provide examples see question 6.3

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	Contract 1	Contract 2	Contract 3
Name of customer organisation			
Point of contact in the organisation			
Position in the organisation			
E-mail address			
Description of contract			
Contract Start date			
Contract completion date			
Estimated contract value			

6.2	Where you intend to sub-contract a proportion of the contract, please demonstrate how you have previously maintained healthy supply chains with your sub-contractor(s) Evidence should include, but is not limited to, details of your supply chain management tracking systems to ensure performance of the contract and including prompt payment or membership of the UK Prompt Payment Code (or equivalent schemes in other countries)

6.3	If you cannot provide at least one example for questions 6.1, in no more than 500 words please provide an explanation for this e.g. your organisation is a new start-up or you have provided services in the past but not under a contract.

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Section 7	Modern Slavery Act 2015: Requirements under Modern Slavery Act 2015 ²⁴	
7.1	Are you a relevant commercial organisation as defined by section 54 ("Transparency in supply chains etc.") of the Modern Slavery Act 2015 ("the Act")?	Yes ☐ N/A ☐
7.2	If you have answered yes to question 1 are you compliant with the annual reporting requirements contained within Section 54 of the Act 2015?	Yes ☐ Please provide relevant the url ... No ☐ Please provide an explanation

²⁴ [Procurement Policy Note 9/16 Modern Slavery Act 2015](#)

Section 8	The General Data Protection Regulation (GDPR) ²⁵	
8.1	Compliance with the GDPR is a mandatory requirement for all contracts or agreements that involve the transfer and processing of personal data from 25th May 2018. Will your organisation be compliant with the GDPR and all Data Protection Legislation (as defined in the terms and conditions applying to this Invitation to Tender) in regards to the processing required under this contract by the time of contract award? Contractors are also required to complete Declaration 5: The General Data Protection Regulation Assurance Questionnaire for Contractors, to evidence the extent of readiness. The Authority may ask the Contractor to provide evidence to support the position stated in the questionnaire. The Authority may require the successful Contractor to increase their preparedness where the Authority is not satisfied that the Contractor will be in a position to meet its obligations under the terms and conditions. If the Contractor fails to satisfy the Authority that it will be in a position to meet its obligations under the terms and conditions in the event that the Contractor is successful, the Authority reserves the right to exclude the bidder from this procurement.	Yes ☐ No ☐

9. Additional Questions

Suppliers who self-certify that they meet the requirements to these additional questions will be required to provide evidence of this if they are successful at contract award stage.

Section 9.1	Suppliers' Past Performance ²⁶ - (please refer to supplier selection guidance - this question should only be included by central government contracting authorities)	
a.	Can you supply a list of your relevant principal contracts for goods and/or services provided in the last three years?	Yes ☐ No ☐

²⁵ [Procurement Policy Note 02/18 Changes to Data Protection Legislation & General Data Protection Regulation](#)

²⁶ [Procurement Policy Note 04/15 Taking Account of Suppliers' Past Performance](#)

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b.	On request can you provide a certificate from those customers on the list?	Yes ☐ No ☐
c.	If you cannot obtain a certificate from a customer can you explain the reasons why?	Yes ☐ No ☐
d.	If the certificate states that goods and/or services supplied were not satisfactory are you able to supply information which shows why this will not recur in this contract if you are awarded it?	Yes ☐ No ☐
e.	Can you supply the information in questions a. to d. above for any sub-contractors [or consortium members] who you are relying upon to perform this contract?	Yes ☐ No ☐

Declaration 5: The Code of Practice for Research²⁷

I confirm that I am aware of the requirements of the Department's Code of Practice for Research²⁸ and, in the proposed project, I will use my best efforts to ensure that the procedures used conform to those requirements under the following headings²⁹:

- ☐ Responsibilities
- ☐ Competence
- ☐ Project planning
- ☐ Quality Control
- ☐ Handling of samples and materials
- ☐ Facilities and equipment
- ☐ Documentation of procedures and methods
- ☐ Research/work records

I understand that the Department has the right to inspect our procedures and practices against the requirements of the Code of Practice, and that I may be asked to provide documentary evidence of our working practices or provide access and assistance to auditors appointed by the Department.

(There is some flexibility in the application of the Code of Practice to specific research projects. Contractors are encouraged to discuss with the Department any aspects that cause them concern, in order to reach agreement on the interpretation of each requirement.)

Signed

Name

Position

Date

²⁷ Please note that this declaration applies to individuals, single organisations and consortia.

²⁸ The Code of Practice is attached to this ITT as Annex 6.

²⁹ Please delete as appropriate.

Declaration 6: The General Data Protection Regulation Assurance Questionnaire for Contractors

See separate document.

Declaration 7: Safe Use of Hydrogen

By responding to this call the tenderer must provide assurance that its staff are competent to work with hydrogen in the declaration below and evidence must be provided to support the declaration.

I declare that the staff that will be working on this project (who are already qualified and extensively experienced in the use of natural gas) have given appropriate consideration to the safety considerations of hydrogen and will put in place procedures to ensure these are followed to provide a safe working environment to complete the tendered work.

Signed

Name

Position

Date

Annex 6: Code of Practice for Research

CODE OF PRACTICE FOR RESEARCH

Issued by the Department for Business, Energy and Industrial Strategy

The Department has developed this Code of Practice from the Joint Code of Practice issued by BBSRC; the Department for Environment, Food and Rural Affairs (Defra); the Food Standards Agency; and the Natural Environment Research Council (NERC) which lays out a framework for the proper conduct of research. It sets out the key aspects of the research process and the importance of making judgements on the appropriate precautions needed in every research activity.

The Code applies to all research funded by the Department. It is intended to apply to all types of research, but the overriding principle is fitness of purpose and that all research must be conducted diligently by competent researchers and therefore the individual provisions must be interpreted with that in mind.

PRINCIPLES BEHIND THE CODE OF PRACTICE

Contractors and consortia funded by the Department are expected to be committed to the quality of the research process in addition to quality of the evidence outputs

The Code of Practice has been created in order to assist contractors to conduct research of the highest quality and to encourage good conduct in research and help prevent misconduct.

Set out over 8 responsibilities the Code of Practice provides general principles and standards for good practice in research.

Most contractors will already have in place many of the measures set out in the Code and its adoption should not require great effort.

COMPLIANCE WITH THE CODE OF PRACTICE

All organisations contracting to the Department (including those sub-contracting as part of a consortium) will be expected to commit to upholding these responsibilities and will be expected to indicate acceptance of the Code when submitting proposals to the Department.

Contractors are encouraged to discuss with the Department any clauses in the Code that they consider inappropriate or unnecessary in the context of the proposed research project. The Code, and records of the discussions if held, will become part of the Terms and Conditions under which the research is funded.

Additionally, The Department may conduct (or request from the Contractor as appropriate) a formal risk assessment on the project to identify where additional controls may be needed.

MONITORING OF COMPLIANCE WITH THE CODE OF PRACTICE

Monitoring of compliance with the Code is necessary to ensure:

- Policies and managed processes exist to support compliance with the Code
- That these are being applied in practice.

In the short term, the Department can require contractors to conduct planned internal audits although the Department reserves the right to obtain evidence that a funded project is carried out to the required standard. The Department may also conduct an audit of a Contractor's research system if deemed necessary.

In the longer term it is expected that most research organisations will assure the quality of their research processes by means of a formal system that is audited by an impartial and competent third party against an appropriate internationally recognised standard that is fit for purpose.

A recommended checklist for researchers can be found on the UK Research Integrity Office (UKRIO) website at <http://www.ukrio.org/what-we-do/code-of-practice-for-research>

SPECIFIC REQUIREMENTS IN THE CODE OF PRACTICE

1. Responsibilities

All organisations contracting to the Department (including those sub-contracting as part of a consortium) will be responsible for the overall quality of research they conducted. Managers, group leaders and supervisors have a responsibility to ensure a climate of good practice in the research teams, including a commitment to the development of scientific and technical skills.

The Principal Investigator or Project Leader is responsible for all the work conducted in the project including that of any subcontractors. All staff and students must have defined responsibilities in relation to the project and be aware of these responsibilities.

2. Competence

All personnel associated with the project must be competent to perform the technical, scientific and support tasks required of them. Personnel undergoing training must be supervised at a level such that the quality of the results is not compromised by the inexperience of the researcher.

3. Project planning

An appropriate level of risk assessment must be conducted to demonstrate awareness of the key factors that will influence the success of the project and the ability to meet its objectives. There must be a written project plan showing that these factors (including research design, statistical methods and others) have been addressed. Projects must be ethical and project plans must be agreed in collaboration with the Department, taking account of the requirements of ethical committees³⁰ or the terms of project licences, if relevant.

Significant amendments to the plan or milestones must be recorded and approved by the Department if applicable.

4. Quality Control

The organisation must have planned processes in place to assure the quality of the research undertaken by its staff. Projects must be subjected to formal reviews of an appropriate frequency. Final and interim outputs must always be accompanied by a statement of what quality control has been undertaken.

³⁰ Please note ethical approval does not remove the responsibility of the individual for ethical behaviour.

The authorisation of outputs and publications shall be as agreed by the Department, and subject to senior approval in the Department, where appropriate. Errors identified after publication must be notified to the Department and agreed corrective action initiated.

5. Handling of samples and materials

All samples and other experimental materials must be labelled (clearly, accurately, uniquely and durably), and retained for a period to be agreed by the Department. The storage and handling of the samples, materials and data must be as specified in the project plan (or proposal) and must be appropriate to their nature. If the storage conditions are critical, they must be monitored and recorded.

6. Documentation of procedures and methods

All the procedures and methods used in a research project must be documented, at least in the personal records of the researcher. This includes analytical and statistical procedures and the generation of a clear audit trail linking secondary processed information to primary data.

There must be a procedure for validation of research methods as fit for purpose, and modifications must be trackable through each stage of development of the method.

7. Research/work records

All records must be of sufficient quality to present a complete picture of the work performed, enabling it to be repeated if necessary.

The project leader is accountable for the validity of the work and responsible for ensuring that regular reviews of the records of each researcher are conducted³¹.

The location of all project records, including critical data, must be recorded. They must be retained in a form that ensures their integrity and security, and prevents unauthorised modification, for a period to be agreed by the Department.

A recommended checklist for researchers can be found on the UK Research Integrity Office (UKRIO) website at <http://www.ukrio.org/what-we-do/code-of-practice-for-research>

³¹ Please note that this also applies to projects being undertaken by consortia.

Annex 7: Exclusion Grounds

Mandatory Exclusion Grounds

Public Contract Regulations 2015 R57(1), (2) and (3)

Public Contract Directives 2014/24/EU Article 57(1)

Participation in a criminal organisation

Participation offence as defined by section 45 of the Serious Crime Act 2015

Conspiracy within the meaning of

- section 1 or 1A of the Criminal Law Act 1977 or
- article 9 or 9A of the Criminal Attempts and Conspiracy (Northern Ireland) Order 1983

where that conspiracy relates to participation in a criminal organisation as defined in Article 2 of Council Framework Decision 2008/841/JHA on the fight against organised crime;

Corruption

Corruption within the meaning of section 1(2) of the Public Bodies Corrupt Practices Act 1889 or section 1 of the Prevention of Corruption Act 1906;

The common law offence of bribery;

Bribery within the meaning of sections 1, 2 or 6 of the Bribery Act 2010, or section 113 of the Representation of the People Act 1983;

Fraud

Any of the following offences, where the offence relates to fraud affecting the European Communities' financial interests as defined by Article 1 of the convention on the protection of the financial interests of the European Communities:

- the common law offence of cheating the Revenue;
- the common law offence of conspiracy to defraud;
- fraud or theft within the meaning of the Theft Act 1968, the Theft Act (Northern Ireland) 1969, the Theft Act 1978 or the Theft (Northern Ireland) Order 1978;
- fraudulent trading within the meaning of section 458 of the Companies Act 1985, article 451 of the Companies (Northern Ireland) Order 1986 or section 993 of the Companies Act 2006;
- fraudulent evasion within the meaning of section 170 of the Customs and Excise Management Act 1979 or section 72 of the Value Added Tax Act 1994;
- an offence in connection with taxation in the European Union within the meaning of section 71 of the Criminal Justice Act 1993;
- destroying, defacing or concealing of documents or procuring the execution of a valuable security within the meaning of section 20 of the Theft Act 1968 or section 19 of the Theft Act (Northern Ireland) 1969;
- fraud within the meaning of section 2, 3 or 4 of the Fraud Act 2006;
- the possession of articles for use in frauds within the meaning of section 6 of the Fraud Act 2006, or the making, adapting, supplying or offering to supply articles for use in frauds within the meaning of section 7 of that Act;

Terrorist offences or offences linked to terrorist activities

Any offence:

- listed in section 41 of the Counter Terrorism Act 2008;
- listed in schedule 2 to that Act where the court has determined that there is a terrorist connection;
- under sections 44 to 46 of the Serious Crime Act 2007 which relates to an offence covered by the previous two points;

Money laundering or terrorist financing

Money laundering within the meaning of sections 340(11) and 415 of the Proceeds of Crime Act 2002

An offence in connection with the proceeds of criminal conduct within the meaning of section 93A, 93B or 93C of the Criminal Justice Act 1988 or article 45, 46 or 47 of the Proceeds of Crime (Northern Ireland) Order 1996

Child labour and other forms of trafficking human beings

An offence under section 4 of the Asylum and Immigration (Treatment of Claimants etc.) Act 2004;

An offence under section 59A of the Sexual Offences Act 2003

An offence under section 71 of the Coroners and Justice Act 2009;

An offence in connection with the proceeds of drug trafficking within the meaning of section 49, 50 or 51 of the Drug Trafficking Act 1994

An offence under section 2 or section 4 of the Modern Slavery Act 2015

Non-payment of tax and social security contributions

Breach of obligations relating to the payment of taxes or social security contributions that has been established by a judicial or administrative decision.

Where any tax returns submitted on or after 1 October 2012 have been found to be incorrect as a result of:

- HMRC successfully challenging the potential supplier under the General Anti – Abuse Rule (GAAR) or the “Halifax” abuse principle; or
- a tax authority in a jurisdiction in which the potential supplier is established successfully challenging it under any tax rules or legislation that have an effect equivalent or similar to the GAAR or “Halifax” abuse principle;
- a failure to notify, or failure of an avoidance scheme which the supplier is or was involved in, under the Disclosure of Tax Avoidance Scheme rules (DOTAS) or any equivalent or similar regime in a jurisdiction in which the supplier is established

Other offences

Any other offence within the meaning of Article 57(1) of the Directive as defined by the law of any jurisdiction outside England, Wales and Northern Ireland

Any other offence within the meaning of Article 57(1) of the Directive created after 26th February 2015 in England, Wales or Northern Ireland

Discretionary exclusions

Obligations in the field of environment, social and labour law.

Where an organisation has violated applicable obligations in the fields of environmental, social and labour law established by EU law, national law, collective agreements or by the international environmental, social and labour law provisions listed in Annex X to the Directive (see copy below) as amended from time to time; including the following:-

- Where the organisation or any of its Directors or Executive Officers has been in receipt of enforcement/remedial orders in relation to the Health and Safety Executive (or equivalent body) in the last 3 years.
- In the last three years, where the organisation has had a complaint upheld following an investigation by the Equality and Human Rights Commission or its predecessors (or a comparable body in any jurisdiction other than the UK), on grounds of alleged unlawful discrimination.
- In the last three years, where any finding of unlawful discrimination has been made against the organisation by an Employment Tribunal, an Employment Appeal Tribunal or any other court (or incomparable proceedings in any jurisdiction other than the UK).
- Where the organisation has been in breach of section 15 of the Immigration, Asylum, and Nationality Act 2006;
- Where the organisation has a conviction under section 21 of the Immigration, Asylum, and Nationality Act 2006;
- Where the organisation has been in breach of the National Minimum Wage Act 1998.

Bankruptcy, insolvency

Bankrupt or is the subject of insolvency or winding-up proceedings, where the organisation's assets are being administered by a liquidator or by the court, where it is in an arrangement with creditors, where its business activities are suspended or it is in any analogous situation arising from a similar procedure under the laws and regulations of any State;

Grave professional misconduct

Guilty of grave professional misconduct

Distortion of competition

Entered into agreements with other economic operators aimed at distorting competition

Conflict of interest

Aware of any conflict of interest within the meaning of regulation 24 due to the participation in the procurement procedure

Been involved in the preparation of the procurement procedure.

Prior performance issues

Shown significant or persistent deficiencies in the performance of a substantive requirement under a prior public contract, a prior contract with a contracting entity, or a prior concession contract, which led to early termination of that prior contract, damages or other comparable sanctions.

Misrepresentation and undue influence

The organisation has influenced the decision-making process of the contracting authority to obtain confidential information that may confer upon the organisation undue advantages in the procurement procedure, or to negligently provided misleading information that may have a material influence on decisions concerning exclusion, selection or award.

Additional exclusion grounds

Breach of obligations relating to the payment of taxes or social security contributions.

ANNEX X Extract from Public Procurement Directive 2014/24/EU

LIST OF INTERNATIONAL SOCIAL AND ENVIRONMENTAL CONVENTIONS REFERRED TO IN ARTICLE 18(2) —

- ILO Convention 87 on Freedom of Association and the Protection of the Right to Organise;
- ILO Convention 98 on the Right to Organise and Collective Bargaining;
- ILO Convention 29 on Forced Labour;
- ILO Convention 105 on the Abolition of Forced Labour;
- ILO Convention 138 on Minimum Age;
- ILO Convention 111 on Discrimination (Employment and Occupation);
- ILO Convention 100 on Equal Remuneration;
- ILO Convention 182 on Worst Forms of Child Labour;
- Vienna Convention for the protection of the Ozone Layer and its Montreal Protocol on substances that deplete the Ozone Layer;
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention);
- Stockholm Convention on Persistent Organic Pollutants (Stockholm POPs Convention)
- Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (UNEP/FAO) (The PIC Convention) Rotterdam, 10 September 1998, and its 3 regional Protocols.

Consequences of misrepresentation

A serious misrepresentation which induces a contracting authority to enter into a contract may have the following consequences for the signatory that made the misrepresentation:-

- The potential supplier may be excluded from bidding for contracts for three years, under regulation 57(8)(h)(i) of the PCR 2015;
- The contracting authority may sue the supplier for damages and may rescind the contract under the Misrepresentation Act 1967.
- If fraud, or fraudulent intent, can be proved, the potential supplier or the responsible officers of the potential supplier may be prosecuted and convicted of the offence of fraud by false representation under s.2 of the Fraud Act 2006, which can carry a sentence of up to 10 years or a fine (or both).
- If there is a conviction, then the company must be excluded from procurement for five years under reg. 57(1) of the PCR (subject to self-cleaning).

Annex 8: Glossary

Adaptable – Refers to the replacement of a minimum number of key components within existing natural gas appliances to allow them to run on hydrogen.

Ancillary System Components – Components required to enable a safe connection to be made from the appliance isolation valve(s), up to and including the ECV.

CHP – Combined Heat and Power generation.

Dual Fuel – Refers to the ability to interchange between gas types without the need to change over components. Definition from BEIS commissioned report 'Appraisal of Domestic Hydrogen Appliances', Frazer-Nash Consultancy, February 2018.

Evaluation criteria – Measures by which the tenders will be assessed and scored.

Exclusive development – The public purchaser reserves all the results and benefits of the development (including Intellectual Property Rights or IPRs) exclusively for its own use.

Hy4Heat – The BEIS Hydrogen for Heat programme to a programme to demonstrate and de-risk the use of hydrogen for heating in GB homes and businesses.

Hydrogen only – Refers to appliances that are designed to run only on hydrogen.

Hydrogen ready – Refers to appliances that are optimally designed to run on hydrogen but initially configured to run on natural gas. These appliances then may require a minimum number of components to be changed at the point of switchover but will have been specifically developed to facilitate this process. Definition adapted from BEIS commissioned report 'Appraisal of Domestic Hydrogen Appliances', Frazer-Nash Consultancy, February 2018.

Like for Like – Defined as having a reference appliance that uses natural gas as a fuel.

Lot – Catering & Production Heating, Dry Space Heating, Wet Space Heating, Combined Heat and Power and Ancillary System Components.

Milestones – Significant points during the delivery of the projects by which progress of the appointed suppliers will be assessed and interim payments made.

mCHP – Micro Combined Heat and Power generation.

PCP – Pre-commercial procurement. Research and development competition.

Pre-Commercial – Pre-commercial covers activities such as solution exploration and design, prototyping, up to the original development of a limited by volume of first products or services in the form of a test series. It does not include commercial development activities such as quantity production.

Project – The development of one hydrogen appliance type.

SBRI – Small Business Research Initiative.

Volume Manufacturing – Refers to the scaling up of hydrogen-fueled appliance manufacture beyond prototype levels, for future purposes such as use in occupied trials or eventual conversion.