

UK-HyRES Hub: Hydrogen and Alternative Liquid Fuels Research Project Call 1

1. Summary of Call Details

Please check your eligibility for EPSRC funding at:

<https://www.ukri.org/councils/epsrc/guidance-for-applicants/check-if-you-are-eligible-for-funding/>

Maximum Value per Proposal	£300,000 FEC*
Funding level available	80 % of FEC
Total resource available for this 1st call	Up to £1,800,000
Expression of Interest call opens	20 December 2023
Information Webinar	12 Jan 2024, 10:00-11:30
Closing date for Expressions of Interest	24 January 2024
Call for Full Proposals opens	28 February 2024
Call for Full Proposals closes	17 April 2024
Peer reviews of full proposals	18 April – 12 June 2024
Meeting of Review Panel	w/c 17 June 2024
Notification of successful and unsuccessful Proposals	1 July 2023
Period for exchange of Flexible Fund grant conditions	1 July – 25 July 2023
Anticipated start date of successful proposals	October - December 2024
*Please see Section 8 - Scope of Flexible Funding Call for further details **If all monies are not allocated in the round, the UK-HyRES Hub Board retains the right to re-allocate funds	

2. UK-HyRES Purpose

Hydrogen and alternative liquid fuels (H&ALFs), such as ammonia, are essential for the UK to reach net zero emissions by 2050. Hydrogen is a highly versatile energy vector suitable for use in many hard-to-decarbonise sectors where other energy options, such as electricity, are not suitable. UK-HyRES aims to identify, prioritise, and seek impactful solutions to research challenges across the entire hydrogen value chain from production via storage and distribution to end use.

3. UK-HyRES Background

The EPSRC has awarded £10.7M to UK-HyRES (<https://ukhyres.ac.uk/>) for a five-year research grant which began 1 June 2023, following an extensive coordination phase from May 2022 to June 2023. In addition to this strong support, UK-HyRES has to date secured £7.0M in leveraged co-funding from industry, civic and other research partners and £8.1M from the Hub's core universities for PhD students and other targeted investments. End use areas include heating,

power, mobility and chemicals. Alternative liquid fuels such as ammonia are also an important theme. There is a strong focus on sustainability and safety in all the Hub's projects. Additionally, with its substantial flexible fund of £5.1M (FEC), UK-HyRES will facilitate a series of calls for new research. These projects must have close alignment with the UK-HyRES themes and be responsive to the research challenges and opportunities identified.

UK-HyRES will drive forward the national effort in hydrogen research that is needed to facilitate this critical area of technology to meet industry and government needs. The team will coordinate a national, interdisciplinary programme of research to ensure a pipeline of projects that can deliver practical hydrogen and alternative liquid fuels technologies that are safe and environmentally, economically and socially sustainable, de-coupling fossil fuels from our energy system and delivering greener energy. The project is led by Director Professor Tim Mays (University of Bath) with Professor Rachael Rothman (University of Sheffield) and Professor Shanwen Tao (University of Warwick) as Co-Directors. University College London, University of Portsmouth, St Andrews University and University of Surrey are core partner universities.

4. The UK-HyRES Hub Structure

UK-HyRES provides a network and collaboration platform for fundamental research, and is a focus for industry, policy and other stakeholder communities, to tackle research challenges that underpin the production, storage, distribution and end use of H&ALFs. The Hub's unique structure has been developed to deliver maximum impact – focusing on four technical themes (production, storage / distribution, end use and alternative liquid fuels), and four cross-cutting themes (environmental, economic, social acceptance and safety). The team will develop UK-HyRES into a global centre of excellence and impact in hydrogen and alternative liquid fuel research within its five-year funding window and into the future.

5. Flexible Fund: Call for Research

The Hub plans to release four calls throughout the five-year programme, to bring together the UK research community in hydrogen and hydrogen-based liquid fuels, both those who are already involved in hydrogen research and those who must be involved in future. Further calls will be announced in 2024, one of which will focus on early career researchers. This is the first of the four calls we intend to announce. The other calls will be released in due course.

6. Funding available

This first call has an allocation of funding in the region of £2M FEC, with proposals requested between £50,000 to £300,000 (FEC) per award. We want to be as flexible as possible to bring various talent and innovative ideas into the Hub, to drive research and innovation in hydrogen and alternative liquid fuels. Projects could be researching new ideas, delivering critical results that may lead to a second stage of collaborative research beyond the initial exploratory work, or impact acceleration with industry partners leading to commercialisation. The projects will be expected to lead to application-inspired research to strengthen the UK's position in hydrogen and hydrogen-based liquid fuels, and ultimately make UK industry more competitive.

Grants will be funded by the UK-HyRES Hub based on 80 % of Full Economic Cost (FEC). Terms of grant awards are based on the UK-HyRES Hub terms, which apply principles of active management. Typical EPSRC conditions are also applied.

7. Project start date and duration

The start date of proposed projects should be between 1 October 2024 and 15 December 2024, depending on whether an existing researcher is ready to work on the project or the recruitment of new researchers is needed. For example, for starting on 1 October 2024, it is likely that researchers will need to already be in post or available on a short timescale. We understand that recruitment of high-calibre researchers can take time, and so a late start date of mid-December 2024 is provided to accommodate this. Full details of the key dates are available at the start of this document.

Projects should have a duration of between 6 and 30 months.

8. Scope of the Call

Successful proposals will be integrated into the existing research programme to deliver novel solutions to enable the wider adoption of hydrogen and hydrogen-based liquid fuels to decarbonise the UK economy. The Hub includes fifteen core projects (Figure 1, PT 1.1 – PT4.1, PC1.1 – PC4.3) already funded by EPSRC through the initial proposal. Information about these projects and the broader UK-HyRES research portfolio is available at: <https://ukhyres.ac.uk/>.

Projects in each Technical Theme are guided and informed by each of the Cross-cutting Themes to ensure appropriate consideration of techno-economics, environmental and societal impacts and safety.

New projects are required to align to either one of the Hub's four technical themes TT1–TT4 or one of the four cross-cutting themes CT1–CT3 (as illustrated in Figure 1). Projects should also align to at least one secondary theme so that all research has primary and secondary alignment to at least one Technical (TT) and at least one Cross-cutting (CT) research theme category.

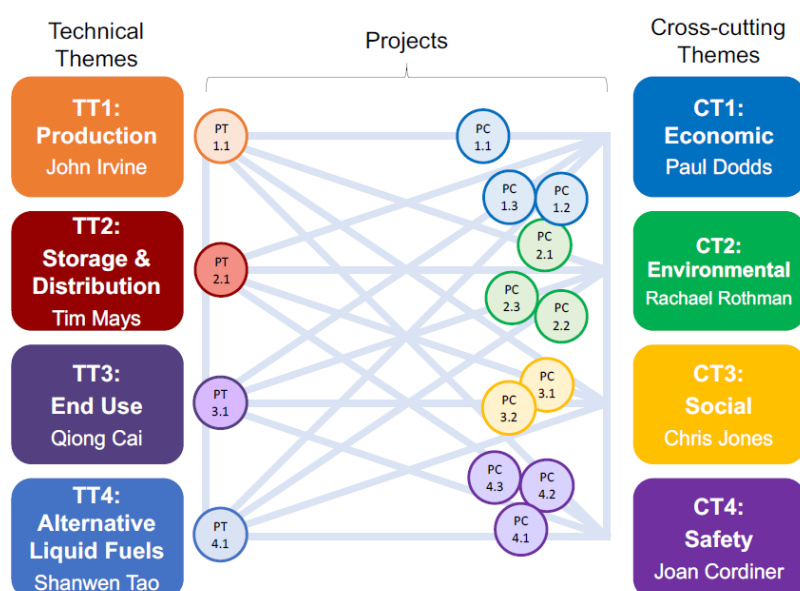


Figure 1: The UK-HyRES Hub structure, showing its themes and leading academics.

Proposed research should either (a), address a defined research challenge (Table 1, A-Z), (b) define a new project aligned to the chosen themes (TT1–TT4 and CT1–CT4). If option (b) is

chosen, the proposer must demonstrate two or more of the following: substantial innovation; fit to UK-HyRES portfolio; addressing critical needs; alignment to UK Hydrogen and Industrial Strategies; evidence of substantial industrial pull or technological push.

Collaborations with industry and other non-academic partners are strongly encouraged. The EPSRC requires 50 % match funding as a Hub; however, we understand that this is not always possible for individual projects and so we will help where we can. We look forward to receiving projects that are co-created, co-developed, and co-funded with industry partners. These projects could be key to addressing fundamental challenges in industry and require research and development to overcome these challenges.

Table 1: Research Challenges identified through the UK-HyRES Hub Coordination phase (May 22- May 23). Research topics and priority research challenges, within the scope of the call, have been identified through five online community engagement workshops involving 330 researchers and industry representatives, engagement with and consultations from over 80 industry and public organisations within the UK over the past two years, the UK Hydrogen Strategy, and the many published roadmaps for H&ALFs in the UK. While these topics are our initial research priorities and projects should indicate alignment, the list is by no means exhaustive.

Challenges	Potential project areas
TT1 Production	
A. Alternative catalysts to Iridium	Alternative oxygen evolution reaction catalysts to Iridium.
B. Anionic exchange membranes	Develop step-change anionic exchange membrane.
C. Solid oxide electrolyser development	Oxygen electrode spalling, hydrogen electrode Ni migration, improving durability and reducing manufacture cost of solid oxide electrolyser technology.
D. Seawater electrolysis research	Fundamental research on seawater electrolysis.
E. Bio-based routes	Bio-based routes to hydrogen production.
F. Solar and nuclear hydrogen production	High-temperature hydrogen production – thermochemical cycles
TT2 Storage and Distribution	
G. Cryogenic material behaviour	Material behaviour under cryogenic/ambient cycling.
H. Permeation barrier development	Develop novel barriers to permeation.
I. Thermal energy recovery	Thermal energy recovery from compression and liquefaction and improvement of compressor technology.
J. Permeation barrier development	Develop novel barriers to permeation.
K. Solid state storage	New solid state concepts and scale-up of existing solid state storage.
L. Cross-cutting: Storage vessel Leakage and failure	Modelling leakage and failure mechanics of storage vessels, including O ₂ / N ₂ condensation.

M. Cross-cutting: H₂ as a GHG modelling	Modelling to understand the effects of H ₂ as a greenhouse gas.
TT3 End Use	
N. Reduction of iron oxide to steel with H₂	Direct reduction of iron oxide to steel with H ₂ .
O. Redesign of cement kilns	Redesign of cement kilns to reduce CO ₂ emissions.
P. Burner improvement to reduce NO_x	Improve H ₂ and NH ₃ burners to reduce NO _x emissions.
Q. Electrode & electrolyte development	New electrode and electrolyte materials for fuel cells, including Chlor-Alkaline development.
R. Cross-cutting: H₂ sensor development	Development of novel H ₂ sensors, e.g. low-cost, in-line, real time & cryo-compatible.
S. Cross-cutting: Point-of-use purification	Develop point-of-use purification.
TT4 Alternative Liquid Fuels	
T. Catalysts for ammonia cracking	Catalyst development for NH ₃ → H ₂ cracking.
U. Electrolysis of ammonia for hydrogen production	Electro-catalysts for electrolysis of ammonia for hydrogen production.
V. Ammonia release safety	Ammonia release safety modelling, including cryogenic ammonia release on water.
W. Reducing NO_x emissions	Modelling the combustion conditions for reduced NO _x emissions.
X. Electrochemical synthesis of green ALFs	Efficient catalysts for electrochemical synthesis of ammonia and other ALFs.
Y. Catalysts for large-scale green ammonia synthesis	Catalysts for green and large scale synthesis of NH ₃ by conventional Haber-Bosch process.
CT1 Economic	
<p>A key outcome of Technical Theme research projects is to improve the economic value of technologies or parts of technologies by, for example, reducing the capital cost, improving the energy conversion or round-trip storage efficiency, increasing the lifetime or durability, or adding flexibility to its operation.</p> <p>The economic theme works with funded research projects and with the other cross-cutting themes to assess the economic opportunities from research projects, considering existing and potential future markets for individual technologies and their system value in meeting future low-carbon technology needs. The systems analysis is carried out in conjunction with the HI-ACT Hub.</p>	
CT2 Environment	
<p>It is essential for any process or product that may switch to hydrogen or an ALF to consider the environmental implications of such a switch. All too often, a change is made to find later that the carbon emissions have, in fact, increased not decreased, or other unintended consequences have occurred. This theme carries out both broad, integrated environmental assessment, as well as specific iterative assessment of the technologies and processes being researched in the projects.</p>	
CT3 Social	
<p>The acceptability and acceptance of innovations in H₂ and ALF technologies and their applications among societal stakeholders (e.g. policy makers, businesses, publics) are</p>	

fundamental to their 'real-world' deployment and (commercial) success. CT3 focuses on better understanding the perceptions and actions of key societal actors and how these shape the social and political context for H2 and ALF technologies.

CT4 Safety

This theme develops and deploys a holistic approach to the evaluation of safety in research projects. The theme considers the processes and scale-up issues associated with hub projects, and it considers the process safety implications. It proposes improvements, changes, and mitigations to enable these processes to be acceptable within the process safety regulation, engineering standards, and, via CT3, the public at large. All of this is done within a resilience framework that considers the impact of climate change on the risk assessment recommendations and recommendations for all the processes to be fit for the future.

9. How to apply

This Flexible Funding Call, for eligible applicants, has three stages:

Stage 1 – Expressions of Interest

- 1) The first stage is a call for Expressions of Interest, EOI (deadline for submissions 24 January 2024 at 15:00 hrs GMT). EOIs are to be submitted electronically via completion of an EOI form which is available on MS Forms [[Stage 1 - Expression of interest form](#)].
- 2) While EOIs should include investigator details these will be redacted on review. Anonymised EOIs will be assessed by the Theme Leads, members of the Strategic Advisory Board and invited external reviewers, based on criteria 1 to 3 as set out in Section 10 of this document. EOIs received will be shortlisted to proceed to the second stage, which will be an invitation to submit a full proposal. Due to the volume of applications expected, there will be no feedback provided to applicants who do not proceed past the EOI stage.

Stage 2 – Full Proposal

Invited full proposals received (deadline for submissions 17 April 2024 at 15:00 hrs GMT) will go through a robust peer review process for Part I, II, and III. Proposals will be assessed based on criteria 1 to 5, as set out in Section 10 of this document. Second stage proposals should consist of the following evidence:

- 1) Part I: Overall Information using the template below – named “<PI surname>_Part_I”.
- 2) Part II: Case for Support including, a project title and a project description comprising clear identification of the research challenge/s the proposal is looking to address, novelty and timeliness, aims and objectives, programme of work including methodology, management including integration into UK-HyRES Hub, impact and dissemination – using the template below with 3 pages maximum, named “<PI surname>_Part_II”
- 3) Part III: Track Record and Justification of Resources (JoR) which includes requested resources and industry support – using the template below with 2 pages maximum, named “<PI surname>_Part_III”.
- 4) Official signed and dated letters of support from project partners, including a statement of the financial value of support offered (cash/in-kind) – named “<PI surname>_partner_<partner name>”.

- 5) Researcher CVs – up to two A4 sides for each named researcher, named “<PI surname>_cv_<researcher_surname>”.

Files can be in Word (.docx) or PDF (.pdf) format. Second stage full proposals should be emailed to UK-HyRESadmin@bath.ac.uk, with the subject line: “UK-HyRES Hub Flexible Funding Call Round 1 – ‘Proposal Name’ – (plus Principal Investigator surname)”.

Part I, II and III and project partner letters of support should be submitted as individual documents in PDF format. Application form available in ANNEX A.

Stage 3 – Review Panel

Peer reviewed proposals will then be submitted to a review panel, including Hub Investigators and members of the Strategic Advisory Board. Peer reviewed proposals at this stage will be shortlisted by the panel against criteria 1 to 5 (Section 10) and ranked to select the final research proposals that will receive the Flexible Fund Awards. Final award decisions will be made using the resulting panel ranked order by the Management Board.

10. Review criteria and assessment process

Proposals will be assessed against the following criteria:

Proposal Assessment Criteria

The panel will score the proposals according to the following criteria. At stage 1, EOI, only criteria 1- 3 apply.

1. Vision and quality (Stage 1 & 2)
 - a. The likelihood that the project will deliver, or lead to, a step-change in knowledge and understanding of the topic and how this could lead to larger scale research activity for further concept development.
 - b. The ambition and adventure of the research and appropriateness of the proposed methodology.
 - c. The innovative approach, relationship to the context of the call and timeliness.
2. Likely impact (Stage 1 & 2)
 - a. Potential of the research to advance the commercial application, policy and/or social environment pertaining to hydrogen and alternative liquid fuels.
 - b. The relevance and appropriateness of beneficiaries identified, collaborators proposed, and the additionality that this offers.
 - c. The understanding of how a breakthrough will contribute to the competitiveness of UK industry.
3. Fit to the Call (Stage 1 & 2)
 - a. Proposals must be within the range of the topic as described in the scope section of this document and be aligned to at least a primary and secondary theme.
 - b. The UK-HyRES Hub reserves the right to reject proposals deemed to be outside of this scope.
 - c. Contribution to a balanced portfolio within the UK-HyRES research programme.
4. Expertise of the applicants (Stage 2)
 - a. The appropriateness of their expertise to the proposed research.
 - b. The potential to participate in longer-term collaboration.
5. Project management (Stage 2)

- a. The effectiveness of the proposed planning and management, including management of risk.
- b. Appropriateness and affordability of the estimated resources.

Where applicants are unsuccessful after stage 2, feedback will be provided in writing within 28 working days of the final decision. Any feedback will be for information only; there will be no opportunity to discuss or appeal the decision.

11. Funded projects required outputs

- 1) For EPSRC funds, a final, publicly disclosable, report and slide pack (5 to 10 slides) that summarises key impacts, findings and follow on work enabled from the research, which will be used to verify completion and inform future activities.
- 2) A project summary which can be published on the UK-HyRES Hub website on announcement of the Flexible Funding award.
- 3) A summary of funding opportunities that the investigators expect the award to enable.

Please note that the research undertaken as part of the UK-HyRES Flexible Funding call is also subject to:

- 1) Discussion and feedback from the Strategic Advisory Board at their biannual meetings.
- 2) Successful applicants attending the UK-HyRES Hub Annual General Assemblies (or other dissemination events as required) to present the findings, impacts and follow on work from their research.
- 3) The PI of flexible fund research projects reporting on the research outcomes to the UK-HyRES Hub to input into ResearchFish and attending intermediate project meetings (in person or remotely) to report on project progress as required.

Use of the Flexible Fund, subsequent outcomes, and activities to support Early Career Researchers and/or Equality, Diversity and Inclusion will be monitored via EPSRC annual reporting requirements and periodic reporting to the Hub Strategic Advisory Board.

12. Terms and Conditions

- 1) Terms and conditions of standard UKRI FEC grant awards apply (<https://www.ukri.org/wp-content/uploads/2021/04/UKRI-161123-FECGrantTermsAndConditions-Nov2023.pdf>)
- 2) All project outputs and engagement should be branded as 'UK-HyRES Hub'. Brand materials and guidance will be provided to successful applicants.
- 3) For published papers EPSRC reference: EP/X038963/1 must be quoted.

13. Equality, Diversity, and Inclusion

The UK-HyRES Hub supports the UKRI Key Principles of Equality, Diversity and Inclusion:

- Equality, diversity and inclusion (EDI) is a critical aspect of a healthy research culture – how projects are designed, carried out and who is involved.
- Research and innovation should be 'by everyone, for everyone' – a dynamic, diverse and inclusive research and innovation system in the UK is an integral part of society and should give everyone the opportunity to participate and to benefit.
- We need to be diverse to accommodate that research and innovation is unpredictable, is often created through new and unanticipated combinations, and can take many forms.
- By recognising and nurturing all people in the system and diversifying interactions, we will enrich our lives by creating knowledge, enabling us to understand the world around us and

empowering us to tackle the many challenges we face as individuals and as communities, nationally and globally.

- The whole workforce are key contributors in the research and innovation system – from the lead researcher or innovator, to those who keep the lights on or maintain the large infrastructure and equipment in our laboratories, small businesses or on our research vessels
- By valuing all, we recognise that a diversity of ideas, opinions, knowledge and people enriches our work and enlarges our knowledge economy

Please note that all questions and comments about UK-HyRES, including about its funding calls, may be directed to UKHyRESadmin@bath.ac.uk. Hub contacts at the EPSRC are Dr Katie Hart (Katie.Hart@epsrc.ukri.org) and Dr Tracey Keys (Tracy.Keys@epsrc.ukri.org).

ANNEX A:
Full Application Form



**UK-HyRES Hub: Hydrogen and Alternative Liquid Fuels Research Project Call 1
Stage 2: Invited Full Proposal**

Part I: Overall Information

INVESTIGATORS (add table cells if more than 2 co-investigators are involved)

PRINCIPAL INVESTIGATOR:	
INSTITUTION:	
EMAIL:	
CO-INVESTIGATORS:	CO-INVESTIGATORS:
INSTITUTION:	INSTITUTION:
EMAIL:	EMAIL:

INDUSTRY PARTNERS (add table cells if more than 2 industry partners are involved)

INDUSTRIAL PARTNER 1 (if appropriate)	INDUSTRIAL PARTNER 2 (if appropriate)
CONTACT NAME(S)	CONTACT NAME(S)
EMAIL:	EMAIL:

PROJECT OVERALL INFORMATION

START DATE:	DURATION:	FUNDING REQUIRED:
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CHOSEN UK-HyRES PRIMARY THEME (TT1-TT4 or CT1-CT4: REFER TO CALL DOCUMENT)

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CHOSEN UK-HyRES SECONDARY THEME(S) (TT1-TT4 and CT1-CT4: REFER TO CALL DOCUMENT)

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CHOSEN UK-HyRES RESEARCH CHALLENGE (choose one from Table 1, A-Z), OR, DEFINE A NEW PROJECT ALIGNED TO CHOSEN THEMES*– PLEASE REFER TO CALL DOCUMENT). *Other research challenges not included on the UK-HyRES priority list are welcome, however proposals will have to substantially demonstrate 2 or more of: significant innovation, fit to UK-HyRES portfolio, addressing critical needs, aligns to UK Hydrogen and Industrial Strategy, evidence substantial industrial pull or technological push.

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Part II: CASE FOR SUPPORT

(3 page maximum, font 11 pt min, margin 2 cm minimum)

Please complete all fields as required, resize cells and delete cell contents as appropriate.

1. PROJECT TITLE (AND ACRONYM IF ANY)

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2. PROJECT DESCRIPTION

Please refer to the assessment criteria in Section 10 of the Call document

PROJECT VISION AND SUMMARY
LIKELY IMPACT
RESEARCH PROJECT AND FIT TO CALL
PROJECT MANAGEMENT

Part III: TRACK RECORD AND JUSTIFICATION OF RESOURCES

(2 page maximum, font 11 pt min, margin 2 cm minimum)

Please complete all fields as required, resize cells and delete cell contents as appropriate.

TRACK RECORD

Please provide a track record for the academics and researchers involved. Describe your previous successful research in this area.

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PROJECT RESOURCES

All project costs should be recorded below. Funding to other academic institutions is made on standard EPSRC grant terms, *i.e.* costs should be calculated on a FEC basis and EPSRC funding will be 80 % of FEC.

			TOTAL COST (100 % FEC)
DIRECTLY INCURRED STAFF COSTS			
STAFF NAME	% FTE	DURATION	COST
SUBTOTAL DIRECTLY INCURRED STAFF COSTS			
TRAVEL AND SUBSISTENCE			
CONSUMABLES			
SUBCONTRACTING			
OTHER			
SUBTOTAL DIRECTLY INCURRED COSTS			
DIRECTLY ALLOCATED STAFF OR OTHER DIRECT COSTS			
ESTATES			
INFRASTRUCTURE TECHNICIANS			
INDIRECT COSTS			
SUBTOTAL DIRECTLY ALLOCATED COSTS			
TOTAL BUDGET (100 % FEC)			
EPSRC FUNDING REQUESTED (80 % FEC)			

<p>JUSTIFICATION OF RESOURCES Please provide a short justification for the resources requested in the table above and why this represents good value for money</p>

INDUSTRY SUPPORT

Please provide details of in-kind or direct support from any industry partners **if applicable**. Copies of letters of support from industry partners are required with this application form **if applicable**.

		PARTNER 1	PARTNER 2	TOTAL
IN-KIND SUPPORT	STAFF TIME			

	TRAVEL AND SUBSISTENCE			
	CONSUMABLES			
	EQUIPMENT/FACILITIES ACCESS			
DIRECT SUPPORT	DIRECT CASH FUNDING			
	OTHER (PLEASE ADD DETAILS)			
TOTAL				

Full proposals should be emailed to UK-HyRESadmin@bath.ac.uk by 15:00 BST on 24 April 2024 with the subject line:

UK-HyRES Call Round 1 – Full Proposal – Proposal name – Principal Investigator surname.