

Please read the full call document for guidance before submitting your proposal

## **Faraday Institution: Final Proposals, Fast Start Research Area Extension**

### **Call Type: Invitation for Full Proposals**

**Closing date: 12:00 noon on the 21<sup>th</sup> of July 2020**

**Funding Available:** TBC. Total Fast Start Extension funding expected to be in the region of £15-20M across four research areas. There should not be an expectation that this will be split evenly between the research areas.

**How to apply:** Only consortia, led by principal investigators invited by The Faraday Institution (FI), containing investigators previously successful as candidates from the Expression of Interest phase are invited to submit full proposals.

**Assessment Process:** Those invited to complete full proposals are asked to submit a set of application documentation, and will be interviewed by an Interview Panel, resulting in review panel recommendations being made to the Faraday Institution on funding.

#### **Expected Key Dates:**

<b>Activity</b>	<b>Date*</b>
Invitations for Full Proposals	Tuesday 9 <sup>th</sup> June 2020
Deadline for Full Proposals	12:00 noon on Tuesday 21 <sup>st</sup> July 2020
Feedback from Introducers	5 <sup>th</sup> August 2020
Response to Introducer Questions	13 <sup>th</sup> August 2020
Interview Panel	w/c 17 <sup>th</sup> August
Funding Decision	w/c 7 <sup>th</sup> of September 2020
Grant Start Date	1 <sup>st</sup> of March 2021

\*The FI aims to adhere to the key dates as published where possible.

**Additional information:** Grants will be funded by the Faraday Institution. The duration of the projects must be 24 months. Continuation of funding after the initial first 12 months is subject to the outcome of the renewal of Faraday Institution funding and Comprehensive Spending Review. The Faraday Institution was established by UK Research and Innovation in 2017 as part of the Industrial Strategy Challenge Fund. Funding of the Faraday Institution is provided from EPSRC. Terms of grant awards are based on Faraday Institution terms which apply principles of active management although certain standard EPSRC conditions are also applied.

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## Summary

Following previous rounds of project scope refinement, and a nationwide call for Expression of Interest (EOI) applications, successful Principal Investigators (PI's) and Co-Investigators (CoI's) in the initial Faraday Institution research areas of Solid State Batteries, Battery Degradation, Multi-Scale Modelling, and Recycling and Reuse are invited to form a consortium of academics to form a final project proposal to submit to the FI by 21<sup>st</sup> July 2020.

The reformed projects will be expected to lead application inspired research, building on the foundations of the three years of investigation already performed, to strengthen the UK's position in electrochemical energy storage research and make UK industry more competitive. These research projects are not intended to be 'business as usual' - they are to be fast paced, focussed projects, delivering transformative results for UK industry. The projects are therefore actively managed by the Faraday Institution to this effect. The FI is looking to extend investment in these four areas with a total investment of between £15-20M, dependant on the quality of research proposed and its relevance to the FI's overall mission.

Proposals will need to have a two-year ambition, and we encourage thought about how outputs could be commercialised, whether directly out of the projects themselves or via collaboration with industry partners. The projects will be due to start on the 1<sup>st</sup> of March 2021 and run until the 28<sup>th</sup> of February 2023. These dates may be subject to any response to the COVID-19 pandemic; when this is clear updated information will be made available via the FI communication channels. The ability to fund these projects hinges on the FI receiving a commitment for future funding from the Government as part of a one-year extension of the Faraday Battery Challenge and beyond that would be dependent upon the comprehensive spending review. We will not be able to award any grants until the one-year extension is in place.

**Full Proposal applications should be submitted by 12:00 noon, on Tuesday the 21<sup>st</sup> of July 2020, by returning the completed application documentation to [programme.manager@faraday.ac.uk](mailto:programme.manager@faraday.ac.uk)**

## Background and Scope

The Faraday Institution, established in 2017, is the UK's independent institute for electrochemical energy storage science and technology, supporting research, training, and analysis. Bringing together scientists and industry partners on research projects to reduce battery cost, weight, and volume; to improve performance and reliability; and to develop whole-life strategies from mining to recycling to second use. It is envisaged that outputs from this research will have a significant influence on technology for electrical vehicles as well as having cross sector benefits for the energy sector and consumer goods.

Research in the areas highlighted is in line with the ISCF Faraday Battery Challenge and forms part of the Government's Industrial Strategy Challenge Fund, which was announced on 21<sup>st</sup> April 2017.

<https://www.gov.uk/government/collections/industrial-strategy-challenge-fund-joint-research-and-innovation>

These projects will form part of a wider programme to enable the UK to strengthen its economy through the establishment and growth of its world-leading capabilities in novel batteries technology. Information about the Faraday Institution Grant is available here: <https://faraday.ac.uk/research-projects/>

The Faraday Institution developed the scope for the original research themes by engaging the industrial, academic and policy community through workshops and other formal means. The outputs from these engagements were ranked on the following criteria:

- Is the topic an application inspired research problem that, if solved, could transform the commercial application of batteries?
- Can the UK be world leading in the chosen research topic?
- Does the topic need to be tackled at scale and with a multi-disciplinary approach?
- Could the UK capitalize on the research benefiting industry and the UK economy?

Following a call, funding was awarded to four consortia covering the areas listed below in March 2018, and now these projects are nearing their three-year completion date. After review, the FI expert panel, executive and board have agreed that the areas remain relevant for further research.

We invite Full Proposals from Principal Investigators and their teams of Co-Investigators who were successful in the initial stages of the Fast Start Research Area Extension process. Further details of each of the four areas are below. It is important to note that these projects should be designed to deliver breakthroughs that can be further developed and used by UK-based industry to create technologies which can be scaled up and industrialised.

## **Area 1 – Project ‘Degradation’**

As stated in the previous stage, Expression of Interest call document, ‘Industrial Strategy Challenge Fund (ISCF) Faraday Battery Challenge: Faraday Institution: Expression of Interest, Research Area Extension’ the project is defined as follows:

To support the rapidly growing adoption of electric vehicles and renewable grid-storage systems, it is desirable to develop lithium-ion batteries with higher energy density and improved rate capability. However, the design of such energy-dense cell chemistries is impeded by a trade-off with cycling and calendar lifetimes. A key goal for the automotive (and utilities) industries is therefore to better understand the causes and mechanisms of degradation. This will enable improved control and prediction of the state of health of battery systems.

Success will deliver exploitable innovations for enhancing battery performance, life and safety, based on a firm understanding of the underlying mechanisms of degradation for the benefit of the UK.

As part of the Faraday Institution, the UK’s independent institute for electrochemical energy storage technology, the Battery Degradation Programme is building new understanding of the underlying physical and chemical processes that can lead to degradation in energy-dense, NMC811 ( $\text{Li}(\text{Ni}_{0.8}\text{Mn}_{0.1}\text{Co}_{0.1})\text{O}_2$ )/Graphite lithium-ion cells as a model system.

To date, the consortium has been applying a variety of analytical techniques to study degradation processes. Sample progress and publications so far include:

- Electrochemical testing, operando synchrotron X-ray diffraction (XRD) and ex situ solid-state  $^7\text{Li}$  nuclear magnetic resonance spectroscopy (NMR) were combined to understand how changes in lithium dynamics correlate with the interlayer spacing changes that occur during delithiation.
- Kerr-gated Raman was used for sensitive measurements of electrode materials and electrolytes with lower background signal than conventional Raman spectroscopy.
- Use of electrical signals together with machine learning to identify degradation pattern.
- Methods for optimising X-ray CT images of a wide range of battery designs and systems have been developed.

The project work is broadly arranged in four main work areas:

- Understanding the chemical drivers of degradation, from the SEI to reactions with the electrolyte to oxygen loss from the cathode.
- Investigating the materials-driven degradation and the interplay between morphology, crystallography and performance of the battery materials.
- The study of the electrochemical signatures of degradation and working to develop predictive models from electrochemical markers of cell performance.
- The production of novel synthesis solutions to help mitigate degradation, including particle coatings, doping strategies, and morphologies.

Particular areas of interest for the next project phase are:

- Developing an understanding of the mechanical behaviour and chemical origins of cracking in high nickel cathode materials

- Studying the role of new electrolyte systems and additives in degradation
- Investigating the chemical and materials origins of safety issues related to the use of high nickel cathode materials
- Investigating commercially relevant higher energy density anode materials

Please also see the following for an overview of the Multi-scale Modelling project:  
<https://faraday.ac.uk/research/lithium-ion/extending-battery-life/>

For select publications from the Faraday Institution research programme, please see:  
<https://faraday.ac.uk/research/research-highlights/>

## **Area 2 – Project ‘Multi-scale Modelling’**

As stated in the previous stage, Expression of Interest call document, ‘Industrial Strategy Challenge Fund (ISCF) Faraday Battery Challenge: Faraday Institution: Expression of Interest, Research Area Extension’ the project is defined as follows:

The Faraday Institution Multi-Scale Modelling (MSM) Project, led by Imperial College London, has brought together theoretical and experimental scientists, mathematicians, chemists, physicists, materials scientists, modellers and engineers from nine academic institutions and thirteen industrial partners to create world-leading computer models that can accurately predict the performance of lithium-ion batteries under different conditions.

The Faraday Institution models draw on the most advanced science in the field — including the work being done by other Faraday Institution projects right now — to ensure that the equations on which they are based reflect the latest and best scientific understanding of what is going on within lithium-ion batteries. The models are being constructed in a way that enables the general equations and the battery-specific parameters within them to be adjusted, as new science reveals more about the fundamental chemical and physical processes within lithium-ion batteries, and as wholly new types of battery are developed.

The MSM project scope spans multiple length and time scales from atomistic to continuum to reduced order models and control. The team is focussed on application-inspired research, and the models being developed will enable designers and users to optimise the performance of the total system from electrode material, through cell design to fully integrated battery packs.

The program proposed would be subdivided into four main areas:

- Capturing complexity – May include advanced methods for solving complex models in batteries and associated systems
- Continuum design for real problems – May include continued tool development to address real world challenges, e.g. health determination.
- Control & estimation methods – May include Reduced Order Modelling development and deployment and end of life prediction.
- Experimental validation and parameterisation – May include Big Data analysis and improved parameterisation techniques.

The Faraday Institution Multi Scale Modelling (MSM) project also seeks to include the follow topics, applied to battery design and management:

- Big data and machine learning across different length-scales
- Reduced order modelling and control optimisation
- Probabilistic forecasting techniques for end-of-life prediction

Please also see the following for an overview of the Multi-scale Modelling project:  
<https://faraday.ac.uk/research/lithium-ion/battery-system-modelling/>

For select publications from the Faraday Institution research programme, please see:  
<https://faraday.ac.uk/research/research-highlights/>

### **Area 3 – Project ‘SOLBAT’**

As stated in the previous stage, Expression of Interest call document, ‘Industrial Strategy Challenge Fund (ISCF) Faraday Battery Challenge: Faraday Institution: Expression of Interest, Research Area Extension’ the project is defined as follows:

The solid-state battery (SSB) is one of the most important challenges in battery research and development. Advances in SSBs would enable step changes in the safety, driving range, charging time and longevity of electric vehicles (EVs). In contrast to work on Li-ion batteries, SSB research stands out as long-term and high-risk, but potentially high-reward. Historically, SSB research has focused on improving the ionic conductivity of solid-state electrolytes (SSE). Ceramic solids, sulphides in particular, are now sufficiently conductive and conductivity is no longer the biggest hurdle facing SSB development. The current barriers are at the electrode-electrolyte interfaces, in the mechanics throughout the cell and in processing at scale.

In response to this diverse set of challenges, The Faraday Institution launched the SOLBAT (solid-state metal anode battery) project in March 2017. A multidisciplinary team of experimentalists and modelers was assembled to unravel the fundamental science underpinning the problems of SSBs. We recognised that the scarcity of understanding is the major barrier to the progress of the technology.

The program subdivides into four areas - WPs 1&2 address the mechanical and chemical stability at the anode and cathode, respectively; WP3 focusses on a different approach to discovering new electrolytes and WP4 on cell fabrication.

To achieve full success, the project will need to incorporate the results of its investigations into a lab-scale, high-power solid-state battery that battery-manufacturers are willing to develop into a commercial product for the benefit of the UK.

In years 1 and 2, the SOLBAT team made great progress in understanding some of the root causes that are preventing the implementation of solid-state devices at scale, and in particular:

- stripping vs plating critical current density
- mechanical properties of metallic lithium
- mechanical modelling of voids and dendrites
- electro-chemo-mechanical modelling
- imaging of lithium metal
- characterization of interfaces
- materials discovery and formulation
- processing and fabrication of solid state devices

In year 3 the project hope to shine a new light on the origins of the failure mechanisms of solid-state batteries.

After careful consideration, the lessons learned and the progress of the international academic and industrial community to date, we believe that the four areas continue to represent the challenges of solid-state batteries. Nonetheless, the effort in years 4 and 5 should be more focused and directed toward identifying solutions. In particular, the following research areas will be prioritised:

- composite solid-polymer electrolytes
- lithium alloys as novel anode materials
- mechanics of ceramics (experiment and modelling)
- interfaces engineering
- coating surfaces of cathode particles

- cathode architecture
- electro-chemo-mechanical modelling
- prototyping
- techno-economics
- materials discovery and formulation
- processing and fabrication of solid state devices

A closer collaboration with key industrial partners will be fundamental in transitioning the knowledge developed over the 5 years toward a prototype of industrial interest. Staying abreast of developments in the market to ensure that the most important challenges are being addressed through close relationships with industrial partners will be essential for this project to have the maximum probability of impact. Relationships with these partners will likely be the first option for commercialisation of any research breakthroughs and to develop the supply chains needed for roll out of solid state battery technologies.

Please also see the following for an overview of the SOLBAT project: <https://faraday.ac.uk/research/beyond-lithium-ion/solid-state-batteries/>

For select publications from the Faraday Institution research programme, please see: <https://faraday.ac.uk/research/research-highlights/>

#### **Area 4 – Project ‘ReLiB’**

As stated in the previous stage, Expression of Interest call document, ‘Industrial Strategy Challenge Fund (ISCF) Faraday Battery Challenge: Faraday Institution: Expression of Interest, Research Area Extension’ the project is defined as follows:

The ReLiB project (Recycling of Lithium Ion Batteries) was set up to support the development of policies, regulations, techniques and processes that will enable safe and sustainable management of end-of-life lithium ion batteries from EVs in the UK.

The project is led by the University of Birmingham and currently has more than 60 active researchers distributed across seven existing university partners and Diamond Light Source. A successful outcome will see the UK demonstrating capability that puts it firmly on the road to a sustainable battery manufacturing, processing and disposal industry.

ReLiB is currently organized into three closely cooperating parallel workstreams:

- Dismantling & Testing - development of testing methods for optimization of reuse, resource recovery and safety; automation of battery pack testing and disassembly.
- Characterization & Recycling - development and optimization of processes for materials reclamation and separation from production scrap and spent lithium ion batteries; advanced characterisation of end-of life cells, reclaimed materials and recycling processes.
- Regulation & Business - Life cycle analysis and techno-economic assessment of recycling processes; development of regulations and policy recommendations to support effective EV battery management in the UK.

After two years of research and development, the project has made significant progress in several areas including:

- Artificial intelligence (AI) algorithms and robotic tools demonstrated for automated pack disassembly and testing;
- a novel diagnostic protocol for battery health which can assess viability for 2nd life use;
- protocols for shredding and physical sorting of cells, and for cell disassembly enabling recovery of 87% of materials;
- training programmes on battery safety and LCA delivered to a range of stakeholders;
- a demonstrator unit produced and tested for a new rapid electrode delamination technique;
- environmental impact assessments of commercial and novel pyrometallurgical processes;

- a life cycle inventory databank on different life cycle stages of LIBs and comparative LCA of delamination processes;
- spatially resolved characterisation of end of life cell materials and production scrap; health & safety analysis of processes;
- short loop recycling of anode and cathode materials demonstrated for electrode remanufacture;
- biochemical pathways determined for cathode digestion and re-precipitation as metal nanoparticles;
- novel binders tested for easier electrode recycling
- policy document on legal frameworks to reduce environmental impacts of transition to EVs and promote recycling
- informed EV policy and regulation makers in UK, EU, US and China.

In years 4 and 5 ReLiB will deliver lasting impact both technically and socially enabling a circular economy for EV batteries to be established successfully for the UK. The project is expected to have three areas of focus:

- Gateway Testing and Dismantling to safely receive, assess, process batteries for reuse or recycling at scale including automated pack and cell disassembly, processing and characterisation including:
  - Optimum pack and cell design for end of life reuse and recycling
  - Chemical characterisation of used cells
  - Developing and validating rapid testing protocols for improved assessment and safety linking electrical testing protocols with characterisation of cells and materials.
  - Developing and prototyping capability for end of life discharge and disassembly
- Recycling and material processing for efficient separation of cell constituents including:
  - Direct recycling processes and ‘upcycling’ of low value cell components
  - Manufacture of cells from reclaimed materials including understanding impact of impurities on the performance of electrode materials
  - Development of prototype delamination and separation technologies
- Research and recommendation for regulators and businesses to support the project and related UK activities with independent techno-environmental-socio-political-economic and life cycle assessments including:
  - Keeping up to date a robust life cycle assessment (LCA) framework for LIBs
  - Evaluating environmental impacts of the battery supply and value chain including final disposal and recycling
  - Recommending design and processing standards

Expressions contributing to the development of novel metal recovery processes that minimise energy inputs and involve the use of renewable and sustainable non-toxic reagents are of particular interest. Proposals that bring in expertise and resources in emerging fields such as AI, big data, remote sensing and synthetic biology are welcomed.

Please also see the following for an overview of the ReLiB project: <https://faraday.ac.uk/research/lithium-ion/recycle-reuse/>

For select publications from the Faraday Institution research programme, please see: <https://faraday.ac.uk/research/research-highlights/>

## Funding available

The funding provided to these research projects will be defined based on the scope and requirements of the proposed projects in collaboration with the Faraday Institution, and dependant on the level of future funding the FI receives. It is expected that £15-20 million will be available across the four projects. It should not be assumed that the funding will be allocated equally between the four research areas.

When preparing full proposals, these projects will be required to work with the Faraday Institution team to refine their project, the work packages and project plan, including a detailed year 1 plan. Universities and applicants should note that successful project proposals need to meet the following conditions - projects must:

- Facilitate the work of the Institution by allowing participating staff the freedom to work solely on the work of the institution i.e. allow participating staff on occasion to work at the headquarters of the Institution and to free up staff time to focus on specific Institution projects, where relevant.
- Accept and comply with specific terms and conditions that will accompany the grant offer letter, as well as adhere to general Faraday Institution terms, conditions and management principles as defined by the following two links. (<https://faraday.ac.uk/wp-content/uploads/2019/09/Terms-and-Conditions-of-Faraday-Institution-FEC-Grants.pdf>) (<https://faraday.ac.uk/wp-content/uploads/2019/09/190923-Faraday-Institution-Project-Management-Plan-v2-2.pdf>)
- Provide access to facilities to other Institutions funded by the Faraday Institution.
- Work with others in the innovation chain, specifically across innovation and scale up activities.
- Be prepared to work with the Faraday Institution HQ and to be directed by the overarching governance structure on the research challenges to be focused on.

All applying universities must acknowledge acceptance of the terms and conditions of the Faraday Institution within their application. These include conditions specifically relating to the management of the outputs from these research projects, such as intellectual property. Applicants will be expected to agree to such terms and conditions as part of the funding process.

## Guidance on writing an application

In addition to the Application Form that you need to submit to the FI (including outline costs and a non-technical summary of the proposal), you will also need to prepare the following attachments:

- **Case for Support** - up to Nine A4 sides
- **Justification of Resources** - up to One A4 sides
- **Work Plan** – up to One A4 sides

Where appropriate you may also need to submit the below documents:

- **Researcher CVs** – optional, up to two A4 sides each, for named research staff (including Researcher Co-Investigators), or visiting researchers. CVs are not required for Principal or Co-Investigators on standard proposals
- **Project Partner Letters of Support** - where applicable, for all named project partners and no page limit
- **Institutional Letters of Support** - where applicable, no page limit
- **Equipment Quotes** – optional, and where applicable with no page limit
- **Equipment Business Case** - is required for any items or combined assets with a value above £138,000 - maximum of one A4 sides (please note there is a restricted capital budget for items >£10K).

Do not submit any other attachments. If submitted, they will not be put forward for peer review.

## Summary of Application Documentation / Attachments

Documentation type	Maximum page length	Mandatory/Optional	Extra Guidance
Application Form	XLS form	Mandatory	Includes Financial and non-technical summary participant information. Includes Project Summary (4000 characters / 500 words)
Case for Support	9 pages	Mandatory	3 x A4 for <b>Track Record</b> , 4 x A4 for <b>Research Vision</b> , 2 x A4 for all other required areas ( <b>National Importance</b> (~0.5 page), <b>Management &amp; Monitoring</b> (~0.5 page), <b>Pathways to Impact</b> (~1 page))
Justification of Resources	One pages	Mandatory	
Work Plan	One page	Mandatory	
CVs	Two pages per	Optional	Optional and only for named PDRAs and visiting researchers.
Project Partner Letters	-	Optional	
Institutional Letters	-	Optional	
Equipment Quotes	-	Optional	One page Equipment Business Case for items >£138k (please note there is a restricted capital budget for items >£10K).

Note: Attachment Format

All attachments must be completed in single-spaced typescript in Arial 11 or other sans serif typeface of equivalent size, with margins of at least 2cm. Arial narrow and Calibri are not allowable font types. Text in embedded diagrams or pictures, numerical formulae or references can be smaller, as long as it is legible. Text in tables and figure labels not within embedded diagrams or pictures should be at least 11 point.

### Case for Support

Following collaboration with the Research Institute team to scope their project ideas to align with the FI objectives, applicants should submit a full proposal covering the following headings. This proposal should be submitted as a **Case for Support** and should be a **maximum of Nine pages of A4** (up to Three pages for Track Record and International Benchmarking, Up to 4 pages on Research programme vision and ambition and up to 2 pages on other areas(National Importance, Management & Monitoring, Pathways to Impact) must be under the following headings. Note the Justification for Resources, is included separately, please see below.

#### 1) Track record and international benchmarking

The track record (including current research grant funding) and current international standing of the main researchers must be articulated. This benchmarking needs to be illustrative in context. Just listing the number of publications or esteem factors is not sufficient; their significance needs to be judged in an international context. An important element of the call is to bring together the best experts inside and outside battery research with relevant expertise. Their track records should explain what important skills and expertise they bring to the project.

The Faraday Institution approach is aligned and consistent with EPSRC on research assessment where reviewers and panel members are advised not to use journal-based metrics, such as journal impact factors, as a surrogate measure

of the quality of individual research articles, to assess an investigator's contributions, or to make funding decisions. Paper content will be considered as more important than publication metrics, or the identity of the journal, in which it was published, especially for early-stage researchers. Reviewers and panel members are encouraged to consider the value and impact of all research outputs (including datasets, software, inventions, patents, preprints, other commercial activities, etc.) in addition to research publications. We advise our peer reviewers and panel members to consider a broad range of impact measures including qualitative indicators of research impact, such as influence on policy and practice. For further info, please see <https://sfldora.org>

The Faraday Institution projects are intended to create an environment where early career researchers are supported and provided with the opportunities to develop their skills by working with the best principal investigators (PI) available. The PI may seek additional support of a project manager / administrator across the lifetime of the project to support the daily running of each work stream. The PI and relevant Co-I's will be bound by the Faraday Institution monitoring and evaluation requirements, and as such, will be expected to frequently engage with the Faraday Institution and relevant governance structures. This will permit interaction with the best researchers in the country and ensure that the most informed guidance available can influence the project. Therefore, the PI and Co-I(s) of this project should actively reflect these considerations when justifying the time contributed to this research project.

## **2) Research programme vision and ambition**

The overall research programme vision and ambition should be articulated in one to two sentences. The vision should be an ambitious but realistic target of what the team seek to achieve during the project and should directly link to achieving outputs to drive UK industry in this area.

As the projects will be monitored throughout their lifetime and managed through the Faraday Institution, then there is an expectation that the vision and ambition of this project will evolve over the project lifetime. Therefore, instead of providing a specific project plan for the lifetime of the grant, applicants are asked to outline the key research challenges and milestones for the first 12 months of the project, with the understanding that these are subject to change.

Applicants must state how their research programme is an ambitious, transformative approach to addressing one of the challenges outlined in this call document.

## **3) National importance**

By definition the Faraday Institution funded research programme projects are in areas of National Importance. In this case the following should be addressed: how the project will ultimately contribute to the competitiveness of UK industry. This must include an understanding of the economic considerations of the technology breakthrough envisaged (especially, what will it do to reduce the cost for UK industry and to improve the performance of a part of UK industry).

The Faraday Institution research topics are shaped by engaging the industrial, academic and policy community, to deliver mission driven, application inspired projects which seek to address problems which, if solved, could transform the commercial application of batteries, make the UK be world leading in the chosen research topic and have a need to be tackled at scale and with a multi-disciplinary approach. These projects should be designed to deliver breakthroughs that can be further developed and used by UK-based industry to create technologies which can be scaled up and industrialised.

The definition of National Importance and further details can be found at preparing new proposals to include National Importance (<https://epsrc.ukri.org/funding/applicationprocess/preparing/includingnationalimportance/>).

#### 4) Management and monitoring

As the project management must fit with the requirements of the Faraday Institution Management Plan, your response under this heading should focus on establishing how the PI, the Project Leader, the project management and administrative support as well as the Co-I team will work together, how they will work with the Faraday Institution and how they will manage the development of PDRAs and PhD students associated with this project.

#### 5) Pathways to Impact

Translation and innovation will be managed in collaboration with the Faraday Institution. The application needs to make a clear commitment to work with the Faraday Institution team to deliver innovation. The proposal should explain how the approach outlined above will deliver a breakthrough that previous research projects in the UK and elsewhere have so far failed to deliver. What novel approaches, new skills, or ways of working will be used? Which stakeholders can you engage with to accelerate impact? And how can we be sure that we are maximising the chances of success? Please ensure that the resources being requested are appropriate for the delivery of project vision and impact.

**Please Note:** The **Case for Support** should be no longer than **Nine Pages** and should follow the above headings format or risk that the proposal may not be considered further.

#### Justification of Resources

You should define the resources required to deliver the project, including the percentage of time dedicated to managing the project, the time the principal and co-investigators will dedicate to the project, and the size, tenure and composition of the research team. You should also describe the role of each of the co- investigators.

The Justification of Resources, taking up to One A4 side, should explain the necessity of your requested resources to your research project, including implementing (5) Pathways to Impact, within your Case for Support. This helps reviewers make informed judgements about whether the resources requested are appropriate for the research proposed. So nothing is missed, The Faraday Institution recommend that you follow the 'Cost to the Proposal' headings used in the application form. For more information on what to do, see how to write a Justification of Resources.

<https://epsrc.ukri.org/funding/applicationprocess/preparing/writing/jor/>

#### Work Plan

You should include a comprehensive plan for the start of the project which should relate to the management strategy with appropriate milestone dates for when important decisions on the direction of the research will be taken. An initial high level Gantt chart is required.

#### Curricula Vitae (CVs)

CVs are not necessary, but should you wish to do so to support the proposal, please only do so for named PDRAs and Visiting Researchers only. CVs are not necessary for any positions, including Principal or Co-Investigators. Should you submit optional CVs, they must not exceed two A4 sides each, may be submitted as a separate attachments. For visiting researchers, include details of previous visits or collaborations with overseas researchers.

#### Project partners Letter of Support

As part of the impact assessment, reviewers will assess whether a collaboration is appropriate; therefore, a good Project Partner Letter of Support shows that the collaboration is genuine and explains why the project partner supports the project.

The project should provide Partner Letters of Support from each key and strategic partner listed, specific to that project. Selected partners must be ones where the support provided is substantive and/or where the potential partner

will form part of a Project Industry Steering Group. Faraday institution will contact key industry stakeholders to confirm their participation prior to project commencement.

Letters should be project relevant, written by project partners when the proposal is being prepared, and dated within six months of the proposal submission date. Standard letters declaring general support for a project are likely to be disregarded by reviewers. For more information, see guidance on what makes a good project partner letter of support.

<https://epsrc.ukri.org/funding/applicationprocess/preparing/writing/lettersofsupport/>

## **University statement & Institutional Letters of Support**

A statement should be provided by the host organisation for the lead Principal Investigator which outlines the support and contribution the university will provide to ensure that the list of expectations outlined above are accepted and successfully achieved. This statement must be both signed and dated.

In exceptional circumstances only, the Faraday Institution accepts Letters of Support that do not meet the requirements for Project Partner Letters of Support. This occurs when an organisation cannot be listed as a project partner, for example when the host institution wants to detail a proposed contribution to the cost of the equipment. There is no page limit for Letters of Support attachments, and letters should be on headed paper, and be signed and dated within six months of the proposal submission date.

## **Equipment quotes**

Three quotations are required for any equipment costing more than £25,000. For equipment in the range £25,000 to £138,000, quotations obtained verbally are acceptable and should be detailed in the proposal. Three written quotations are required for single items of equipment costing more than £138,000 and must accompany the proposal. Quotes should include VAT, delivery charges and incorporate any standard academic discounts. For any items or combined assets with a value above £138,000 a one-page Equipment Business Case must be included in the proposal documentation (please note there is a restricted capital budget for items >£10K).

Where you believe that there are less than three potential suppliers for an item you should explain this in the Justification of Resources.

Please refer to Ethical Information section for the demonstration of consideration of ethical issues related to materials to be used during the course of the project.

Faraday Institution has a restricted capital budget to this call for equipment requests over £10K. The capital budget will be allocated to successful full proposals based on the advice of peer review and discussions with the applicants and partners.

## **Assessment**

### **Assessment Process**

A two-stage assessment process has been used of which this call is the second stage. Only consortia, led by principal investigators invited by The Faraday Institution, containing investigators previously successful as candidates from the Expression of Interest phase are invited to submit full proposals. Any uninvited submissions will be automatically rejected without further consideration.

## Stage 2: Full Proposal

Full proposals should be submitted and will be subject to peer review. The final recommendations for funding will be made by a Review Panel, composed of independent experts, following interviews conducted with representatives of the bidding projects. Proposals will be measured against the Full Proposal Assessment Criteria listed below. The process shall be in line with the following:

- Upon submission of Full Proposals, the Faraday Institution shall distribute applications to the members of the Full Proposal review panel, along with appropriate review guidance and briefing notes.
- Panel members shall be initially given approximately two weeks to review the document sets.
- At issue of review documents, Primary and Secondary Introducers will be assigned to each research theme area, by the Faraday Institution.
- An Introducer is a member of the review panel whose roles will be to lead the discussions in the review panel.
- As part of this review process the Introducers will also provide support for written peer review.
- Written peer review gives applicants a right to reply prior to the interview stage. This will allow applicants an opportunity to correct factual inaccuracies and respond to any queries raised by the reviewers.
- The written peer review will be provided to the applicants after that initial two-week proposal review period.
- The applying consortium Principal Investigator will then have 5 working days, from issue, to respond to the written peer review on behalf of bidding consortium.
- Applicants, for each of the four research areas, shall be invited to attend an interview with the Full Proposal stage Review Panel. The Principal Investigator and 2 nominated Co-Investigators for each proposed project will be requested to attend this Interview session which will comprise a short presentation followed by Q&A with the Review Panel.

Specific details on interview process will be provided to applicants in due course.

## Role of Reviewers

The FI will convene a panel to assess the research quality of the Final Proposals received for the Fast Start Research Area Extension. This review will be conducted by a panel of independent experts. The Full Proposal review panel will be composed of individuals from both Industry and Academia, internationally renowned experts in the areas of electrochemical energy storage, battery technology research and battery engineering. Independent International Experts forming the Full Proposal stage panel shall be entirely separate to those of the EOI review stage. Independent Industry Experts, who participated at the EOI stage, will support the full proposal review for the single specific research area/project for which they supported that EOI review panel for.

The role of the Full Proposal stage panel will be to review and provide recommendations to the FI project proposals. The role of the FI will be to convene and facilitate the Full Proposal stage panel review meeting and not to participate in the discussion or scoring of proposals.

Please refer to the following table for a definition of the role and responsibilities of individuals participating in the Full Proposal stage review.

Review Participants	Role	Responsibility
<b>Independent International Experts</b>	Highly experienced Independent Industry or Academic expert in the field.	To review, score and provide recommendations on Full Stage applications. To act as primary or secondary introducer to lead the discussion. Introducers will provide written peer review comments ahead of the interview panel. The FI will send to PI applicants who will have 5 days to respond if necessary.
<b>Independent Industry Expert(s)</b>	Highly experienced Independent Industry Expert(s) in the field, both UK and International based.	To review, score and provide recommendations on Full Stage applications. To have participated in the previous stage Expression of Interest Review Panel. To participate in the Full Proposal review for the single and specific research area/project for which they supported the EOI Review Panel stage for.
<b>FI Management Team Members</b>	FI Head of Programme Management. FI Head of Technology Transfer. To manage the review process to deliver outcomes and reach conclusion. To actively manage the FI wide research portfolio of projects, to deliver impact and strategic goals.	To brief the panel members and to provide ongoing guidance. To have visibility of the EOI and Full Proposal stage applications and content. To convene and facilitate the EOI and Full Proposal stage panel review meetings, to take notes, manage conflicts of interest and ensure fairness of the peer review discussions to ensure that no applications will be reviewed based on protected characteristics. To consider the recommendations of the panel to reach a decision on progression and on next steps.

## Final Proposal Assessment Criteria

At the interview assessment stage the panel will score the proposals according to the following criteria:

### Likely Impact (Joint Primary)

- Potential of the research to advance the commercial application of battery technology.
- The relevance and appropriateness of beneficiaries identified, and collaborators proposed.
- The understanding of how a breakthrough will contribute to the competitiveness of UK industry.
- Contribution to other research areas, societal challenges, success of the UK economy, emerging industries.

### Vision and Quality (Joint Primary)

- The likelihood that the project will deliver step-change in knowledge and understanding of the topic.
- The ambition and adventure of the research.
- The innovative approach, relationship to the context and timeliness.
- The appropriateness of the proposed methodology.

### Fit to the call (Joint Primary)

- Proposals must be within the range of the topic as documented by the final proposal call document.
- The FI reserves the right to reject proposals deemed to be outside of this scope.
- Contribution to a balanced portfolio across the FI research programme.

### Quality of the Applicants

- the standing of the applicants as demonstrated by their track record.
- The appropriateness of their expertise to the proposed research.

### Resources and management

- The effectiveness of the proposed planning and management, including management of risk.
- Appropriateness and affordability of the estimated resources (including equipment).

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

## Outcomes of the Final Proposal Review Process

Following the recommendation from the panel interview the FI will enter into a negotiation period with each Principal Investigator and project team to ensure that the proposed Management and Resources align to the level of financial support, that relevant reviewer recommendations are taken into account and that the FI is balancing a portfolio and strategic priorities. The FI will then present final recommendations for project funding to the FI Board.

## How to apply

### Submitting an application

Please submit the completed application proforma via email to [programme.manager@faraday.ac.uk](mailto:programme.manager@faraday.ac.uk) by 12:00 noon, on Tuesday the 21<sup>st</sup> of July 2020. Please ensure sufficient time is given to each participating institution to follow their own internal sign off processes and to submit accurate financial information.

### Guidance on writing an application

The Faraday Institution grant awards are not the same in all aspects of terms and condition (please also see Funding Available, above) as those defined by EPSRC, but where specified in this document, the Faraday Institution does apply standard EPSRC principles and guidelines.

For information on the eligibility of organisations and individuals to receive funding from this programme, see refer to the EPSRC Funding Guide: <https://epsrc.ukri.org/funding/applicationprocess/fundingguide/>

A list of organisations eligible to apply is provided at: <https://www.ukri.org/funding/how-to-apply/eligibility/>

Providing you were successful at the Expression of Interest stage, it is possible you will be invited to input to the Final Proposal for multiple projects in this round of funding. Please read this document and the framework document in the appendix prior to submitting your application. If you have any questions, please use the contact details available on the front page.

## Equipment

Researchers are expected to make use of existing facilities and equipment, including those hosted at other universities. Should equipment in addition to that already available to the research consortium within their own organisation or within other FI funded projects be required individual items of equipment over £10,000 in value may be included however but research organisations will be expected to make a contribution to the cost.

Faraday Institution has a restricted capital budget to this call for equipment requests over £10K. The capital budget will be allocated to successful full proposals based on the advice of peer review and discussions with the applicants and partners.

Requests for equipment over threshold for EPSRC Strategic Equipment will not need to go through the separate Strategic Equipment Process but will be considered as part of the assessment of proposals. Please note: This call is not for the creation of a national equipment facility or service.

For more information on equipment funding, please see: <https://www.epsrc.ac.uk/research/facilities/equipment/>

Please also refer to section on Equipment Quotes for additional information.

## Training & High Performance Computing (HPC) Costs

Applicants must include, within their proposal, a provision of £3k per year, per PDRA, to support personal development and training for Faraday Institution funded PDRAs.

Applicants requiring access to high performance computing resources, via the Faraday Institution's dedicated computing cluster MICHAEL, or otherwise, are expected to indicate within their Justification of Resources the total number of millions of core hours requested for their proposal. The Faraday Institution will inform applicants at a later date on any costs which may need to be provisioned by a project for allocation of HPC resource.

Both of the above costs should be called out as specific line items in the proposal and budget statements, where applicable.

## Equality, Diversity and Inclusion

The Faraday Institution aspires to create a truly inclusive environment where all its researchers can thrive and feel a sense of belonging whilst empowering everyone to have a voice. We celebrate individuality and know that combining the skills and talents of a dynamic and diverse community brings great strength. The Equality, Diversity and Inclusion Working Group, headed up by CFO Susan Robertson, is looking at positive ways to ensure these values are lived out throughout our community. <https://faraday.ac.uk/edi-working-group/>

The Faraday Institution is a member of WISE and committed to promoting gender balance in science, technology and engineering. <https://www.wisecampaign.org.uk/>

The long-term strength of the UK research base depends on harnessing all the available talent and the Research Councils have together developed the ambitious UK Research and Innovation Equality, Diversity and Inclusion Action Plan <https://www.ukri.org/files/legacy/skills/action-plan-edi-2016/>

In line with the UK Research and Innovation Diversity Principles, The Faraday Institution and EPSRC expects that equality and diversity is embedded at all levels and in all aspects of research practice. We are committed to supporting the research community in the diverse ways a research career can be built with our investments. This includes career breaks, support for people with caring responsibilities, flexible working and alternative working patterns. With this in mind, we welcome applications from academics who job share, have a part-time contract, need flexible working arrangements or those currently committed to other longer, large existing grants. Please also see the EPSRC Equality and Diversity webpages <https://epsrc.ukri.org/funding/equalitydiversity/> for further information.

## Ethical Information

Applicants should use the Further Information section on the Application Form to demonstrate to peer reviewers that they have fully considered any ethical issues concerning the material they intend to use, the nature and choice, current public perceptions and attitudes towards the subject matter or research area. The Faraday Institution will not fund a project if it believes that there are ethical concerns that have been overlooked or not appropriately accounted for. All relevant parts of the Further Information section must be completed. If the research will involve human participation or the use of animals covered by the Animals (Scientific Procedures) Act 1986 it is recommended that applicants pay particular attention to the guidance highlighted below. The Faraday Institution reserves the right to reject applications prior to peer review if the Ethical Information sections are not completed correctly.

Other relevant guidance includes: EPSRC's policy on animal use in research  
<https://www.epsrc.ukri.org/about/standards/animalresearchpolicy/>

And the Responsible Innovation Framework <https://epsrc.ukri.org/research/framework/>

## Application Assessment & Portfolio Approach

The FI applies a ‘portfolio’ approach in funding competitions. The portfolio will be spread across a range of:

- Scope areas
- Categories of research and development
- Project durations
- Project costs, including demonstrating value for money

This is to fit the spend profile of the competition. It will make sure that funds are allocated across the strategic areas identified in the scope of the competition. Successful applications are all required to meet a quality threshold. The FI reserve the right to manage the portfolio to achieve the correct balance of projects and funding.

Specifically, please note that the Faraday Institution will not participate in the scoring of proposals at both Expression of Interest and Full Proposal Stages.

Following Full Proposal review, the review panel will make recommendations to the FI Executive who will use these to inform the final recommendations which they will develop. These recommendations will be presented to the FI Board of Trustees who will make a final decision. Confirmation of outcomes of the Fast Start Research Area Extension process will be subsequently made by the FI.

## Conflicts of Interest

The Faraday Institution is committed to maintain the highest standards of impartiality, transparency and fairness in all aspects of its work. From time to time a situation can arise where there is a conflict of interest. This is particularly the case where the FI requires expert advice and those best placed to provide the required expertise may be actively involved in the field. These situations will be managed by adopting a clear policy for dealing with potential conflicts.

The Faraday Institution requires all individuals involved in such activities to agree to act according to our policy on conflicts of interest which is available on the FI website from the following links.

<https://faraday.ac.uk/conflicts-of-interest/>

<https://faraday.ac.uk/wp-content/uploads/2019/07/FI-Conflicts-of-interest-policy-11.07.2019.pdf>

Reviewers should declare any potential conflict of interest and panel members will not be present during any discussions of proposals in which they are conflicted.

Below are a set of guidelines that all reviewers (be they academics, from industry or FI management) will be expected to comply with.

- A conflict of interest shall be defined as any personal, business or academic interest which may, or may be perceived to (by a reasonable member of the public), influence your judgement in performing your functions and obligations as regard the FI fast start research area continuation process.
- It is expected that reviewers inform the FI in advance of any new appointments that may give rise to a conflict of interest as described above, and affect the performance of your functions and obligations as regard the continuation of the FI fast start research areas.
- Where a conflict of interest becomes apparent during the course of the continuation process you are required to inform the FI and other parties at the earliest opportunity.
- Reviewers are required to withdraw from any discussions where you have any interests that may, or may be perceived to, influence your judgement or give rise to a personal, business or academic gain of detriment to other parties.
- All information on potential conflicts of interest will be held by the FI and could be disclosed to stakeholders and funders of the activities of the FI (and potentially also the public).

## Confidentiality & Privacy

The Faraday Institution Privacy Policy, which describes how we manage personal data can be accessed on our website from the following link. <https://faraday.ac.uk/privacy-policy/>

The Faraday Institution assess all the grant applications through a review process proposal and such applications are sent to reviewers for comment. Applications are treated confidentially and only supplied to reviewers who have previously signed confidentiality agreements with the Faraday Institution.

Reviewing panel members are asked not to share or discuss reviewer comments/identities outside of the Faraday Institution management. Reviewers are asked for feedback forms. The content of applications, proposals and feedback forms are all kept confidential. If reviewers have any paperwork or have any additional notes, they are required to keep these secure and delete them as soon as the information is no longer required.

Whilst we ask within their submissions that applicants describe their proposed project in sufficient detail for reviewers to assess the application, potentially patentable results should not be included in a proposal until after a patent application has been filed.

Under no circumstances should any applicant contact individual panel members. Reviewers are required to notify us immediately if any applicant contacts them directly. Under no circumstances should any Review Panel member contact bidding individuals.

## Guidance for reviewers

The Faraday Institution will issue guidance documentation to the Full Stage proposal Review Panel at the time of providing project documentation for review.

## Key dates

Activity	Date*
Invitations for Full Proposals	Tuesday 9 <sup>th</sup> June 2020
Deadline for Full Proposals	12:00 noon on Tuesday 21 <sup>st</sup> July 2020
Feedback from Introducers	5 <sup>th</sup> August 2020
Response to Introducer Questions	13 <sup>th</sup> August 2020
Interview Panel	w/c 17 <sup>th</sup> August
Funding Decision	w/c 7 <sup>th</sup> of September 2020
Grant Start Date	1 <sup>st</sup> of March 2021

\*The FI aims to adhere to the key dates as published where possible but applicants should be aware that slippage may occur.

## Contacts

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### Allan Paterson

Head of Programme Management, Faraday Institution

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If you have any questions about preparing and submitting your proposal, please contact Craig Chapling ([craig.chapling@faraday.ac.uk](mailto:craig.chapling@faraday.ac.uk)). Your Research Administration should also be able to offer advice about writing your proposal. Please allow enough time before the closing date.

## Change log

Name	Date	Version	Change
Craig Chapling	12/05/20	1.0	First Draft
Allan Paterson	22/05/20	1.1	Updates to reflect EOI Supplementary Documentation and changes to application and submission process.
Craig Chapling	30/05/20	1.2	Updates based on feedback and formatting changes.
Allan Paterson	05/06/20	1.3	Updated based on additional feedback
Allan Paterson	07/06/20	1.4	Further refinement of text and structure
Allan Paterson	08/06/20	1.5	Incorporation of additional comments
Allan Paterson	09/06/20	1.6	Incorporating additional review comments/corrections.

## Appendices

### Application Documentation and Attachments Check List

Documentation type	Maximum page length	Mandatory/Optional	Extra Guidance
Application Form	XLS form	Mandatory	Includes Financial and non-technical summary participant information. Includes Project Summary (4000 characters / 500 words)
Case for Support	9 pages	Mandatory	3 x A4 for <b>Track Record</b> , 4 x A4 for <b>Research Vision</b> , 2 x A4 for all other required areas <b>(National Importance (~0.5 page), Management &amp; Monitoring (~0.5 page), Pathways to Impact (~1 page))</b>
Justification of Resources	One pages	Mandatory	
Work Plan	One page	Mandatory	
CVs	Two pages per	Optional	Optional and only for named PDRAs and visiting researchers.
Project Partner Letters	-	Optional	
Institutional Letters	-	Optional	
Equipment Quotes	-	Optional	One page Equipment Business Case for items >£138k (please note there is a restricted capital budget for items >£10K).

Please ensure you adhere to the above attachment requirements when submitting your proposal.

Any missing, over length or unnecessary attachments may result in your proposal being rejected.

#### **Please Note : Attachment Format**

All attachments must be completed in single-spaced typescript in Arial 11 or other sans serif typeface of equivalent size, with margins of at least 2cm. Arial narrow and Calibri are not allowable font types. Text in embedded diagrams or pictures, numerical formulae or references can be smaller, as long as it is legible. Text in tables and figure labels not within embedded diagrams or pictures should be at least 11 point.