Statement of requirement

Reducing the cost and improving the performance of battery technologies for use in developing countries and emerging economies

Introduction

The Faraday Institution is the UK's independent institute for electrochemical energy storage science and technology, supporting research, training, and analysis. We bring together scientists, industry partners, and government funding with a common goal. We invest in collaborative research to reduce battery cost, weight, and volume; to improve performance and reliability; to develop scalable designs; to improve our manufacturing; to develop whole-life strategies from mining to recycling to second use; and to accelerate commercialisation.

Bringing together expertise from universities and industry, and as part of the Faraday Battery Challenge, the Faraday Institution endeavours to make the UK the go-to place for the research, development, manufacture and production of new electrical storage technologies for both the automotive and the wider relevant sectors.

With respect to this call, the Faraday Institution has received funding from UK aid to research new battery technologies and conduct relevant techno-economic and related studies that have the potential to increase the uptake of cheap, clean and reliable energy in Overseas Development Assistance (ODA)-eligible countries. The UK aid support is provided as part of the Transforming Energy Access programme, which supports early stage testing and scale up of innovative technologies and business models that will accelerate access to affordable, clean energy based services to poor households and enterprises, especially in Africa.

Overview

The Faraday Institution is launching a research programme which will develop the potential of new battery technologies for use in developing countries and emerging economies. The goal of this research is to accelerate the delivery of both reliable and sustainable energy in developing countries and emerging economies with on-grid and significant off-grid and weak grid populations.

The growth in battery technologies globally and particularly those used in electric vehicles is fuelling a rise in electrochemical energy storage in both static and mobile applications. Emerging battery technologies are one solution to support the provision of clean, reliable energy to millions of people in developing countries and emerging economies. However, high upfront costs of new battery technologies, coupled with uncertainty around performance and reliability, mean that, for example, lead-acid batteries are still used in many static applications as they are the cheapest and most mature option, despite their poor performance, shorter lifetime and possibly higher total cost of operation.

Last year, the Faraday Institution commissioned a scoping study "Rapid market assessment of energy storage in weak and off-grid contexts of developing countries", conducted by Vivid Economics, to help inform the direction of this research call. The outputs of the report include identifying the market potential of battery and other energy storage technologies and identifying some of the leading technological solutions which offer high potential impact.

The Objective

The scoping study report highlights the need to bring down upfront costs and increase overall financial competitiveness to allow newer technologies to compete. This research programme will focus on pre or recently commercialised technologies that have the potential to be a cost-effective alternative to established technologies, such as lead acid lithium-ion. These include, but are not

limited to, flow batteries, zinc-air and copper-zinc batteries. Research will focus on the following:

- Battery chemistries that have the potential to significantly lower costs, including those addressing energy density, depth of discharge and cycle life
    - Battery architectures that have the potential to lower costs
    - Materials that have potential to scale and lower costs e.g. high value cell components, lower cost cathodes
    - Efficient manufacturing techniques
- Reducing the cost of more mature technologies, e.g. flow batteries, by:
    - Developing low-cost materials that lower upfront costs
    - Research improvements in efficiency that can unlock system cost reductions
- Demonstrating the scale-up of technologies to help develop efficient manufacturing techniques and lower risks

The overall objective or outcome of the research is to specify battery chemistry, performance, materials, manufacturing processes and whole-life cost reductions that contribute to new batteries being competitive, compared to existing solutions, and will encourage and accelerate their up-take and roll-out in developing countries and emerging economies to enable cheaper, cleaner and more reliable energy. A key output of the research will be to identify the differential cost and/or performance improvements that could be achieved.

The Scope

All battery technologies are in scope, with the exception of the lithium-ion, sodium-ion, and lithium-sulfur, which are already being researched as part of the wider Faraday Institution research programmes.

Research on the performance of nascent technologies such as zinc-air, copper-zinc and flow batteries, which offer the potential to provide low-cost solutions, but where there are still barriers to wider commercial scale-up, are encouraged.

Projects that help reduce the costs, increase the performance/lifetime, address whole life including end-of-life costs or improve the scale-up of relevant technologies will be prioritised. Projects that will help enable the reduced use or replacement of diesel and petrol generators are also of particular interest, however projects that address any of the following use-cases are in scope:

- Off-grid households/residential –behind the meter energy use e.g. household solar systems, lanterns and back-up power
- Off-grid villages/towns – as part of mini-/micro-grids
- Off gird or weak grid commercial/industrial/agri-processing/use
- Off-grid or weak grid power for critical infrastructure (e.g. clinics, schools, telco infrastructure and banking)
- In building grid-connected power storage/backup power
- Larger scale grid storage, back-up utility and grid balancing
- Grid frequency and voltage response where the application is shown to be of value to emerging economies

Research groups should have strong links with relevant industrial partners who will have an active role in the project and where willingness to work or experience of working in ODA countries would be advantageous.

The Requirements

Project proposals are invited that seek to positively contribute to the ultimate objective or outcome of this research programme which is to specify battery chemistry, performance, materials, manufacturing processes and whole-life cost reductions that contribute to batteries being competitive, compared to existing solutions, and will encourage and accelerate their up-take and roll-out in developing and emerging countries to enable cheaper, cleaner and more reliable energy.

Project proposals should describe the research that is intended to be performed via this call and include a list and brief description of the intended outputs of that research. Proposals should also describe how those outputs link to or support the ultimate objectives and outcomes of this research programme, whether now or in the future.

Project proposals should also list and briefly describe each of the activities that they intend to perform to deliver their research and also show how the intended outputs link to those activities or combination of those activities.

Project proposal should also briefly describe the inputs that will be required for each of the proposed activities. e.g. staff time, laboratory time, equipment and physical materials, data, existing knowledge and analysis.

Inputs ➔ Activities ➔ Outputs ➔ Outcomes

Where possible project proposals should also identify additional elements that will be required such as:

- Technical review of relevant market and academic literature
- Collaborators and partners to help shape, and/or deliver, the research

A key output of the research will be to identify the differential cost and/or performance improvements that this research will help to deliver in terms of its ability to contribute to encouraging and accelerating its up take in developing countries and emerging economies.

Examples of the type of projects that will be considered include but are not limited to research that will:

  - reduce the costs of materials
  - increase efficiency, power output, energy density
  - improve cycle life and rate capability
  - improve manufacturing processes
- Benchmark the performance of new materials against existing technologies
- Demonstrate potential scale-up and cost savings

Indicative Budget

A budget of up to £1,000,000 ex VAT is available for this activity. 2-4 projects, each of up to two and a half years in duration, will be funded. Tenderers should quote their price using this proposal template that will available on the Faraday Institution website shortly. The figure before VAT is the figure that will be used for evaluation.

Reporting

- Selected proposals will be invited to provide a draft project plan where the phasing, timing and key deliverables and milestones are agreed, prior to signing of the contracts.
- A more detailed project plan, detailing the approach to delivering this project, will be provided within two months of signing of the contracts.
- This programme is part of the wider Transforming Energy Access (TEA) programme, which is managed by The Carbon Trust and progress will be reviewed in consultation with The Carbon Trust and DFID.
- Formal quarterly updates and 6-monthly reporting, to the Faraday Institution, is required.
- It is expected that successful projects will provide a brief update on progress approximately every 1 month during the project period.

Timeframe

Research projects are envisaged to last for a period of up to 24-30 months.

Contact points

Successful projects will report directly to the Programme Manager at the Faraday Institution.

For questions about this opportunity, please contact Andrew.deadman@faraday.ac.uk or Ian.ellerington@faraday.ac.uk

Competition Criteria

Research groups should have appropriate experience of similar or related battery and/or materials science research and development.

The assessment criteria will be:

- Exploitation potential and potential for transformational impact of the research programme in emerging markets (30%)
- Experience of working in emerging markets, or technologies for emerging markets (20%)
- Alignment to scoping study requirements (20%)
- Track record of research team (15%)
- Value for money / price (15%)

Each criterion will be scored through a paper sift. The assessors may invite one or more bidders for a clarification interview prior to making a final decision. The proposals will be re-scored after the interview. Scoring below a set hurdle rate in any criterion will eliminate the proposal.

Faraday Institution may take a portfolio approach to selection of the proposals. Where more than one proposal is in the same or substantially similar area of research, the highest scoring one will be selected and the other may be rejected in favour of a lower scoring proposal in order to increase the breadth of the programme.

This call is open to all research organisations, who must also lead the project. Grants will be issued subject to the Faraday Institution's standard terms and conditions.

The closing date for proposals is 11 May 2020.

The successful proposals will be invited to agree final contract terms and start work summer/autumn 2020.