



UNITED STATES ADVANCED BATTERY CONSORTIUM LLC

**DEVELOPMENT OF A CELL USING RECOVERED ACTIVE MATERIALS FROM END OF
VEHICLE LIFE Li-ION BATTERIES**

REQUEST FOR PROPOSAL INFORMATION (RFPI)

DEVELOPMENT OF A CELL USING RECOVERED ACTIVE MATERIALS FROM END OF VEHICLE LIFE Li-ION BATTERIES

REQUEST FOR PROPOSAL INFORMATION (RFPI)

TABLE OF CONTENTS

1. Statement of Purpose/Objectives
2. Business Objectives
3. Development Timing
4. Business Case
5. Technical Challenges
6. Information Requested
 - 6.1 Company/Team Background
 - 6.2 Proposed Electrochemical Energy Storage Technology
 - 6.3 Proposed Technology Development Plan
 - 6.4 Project Schedule, Deliverables, Cost, and Cost Sharing
 - 6.5 Project Team Organization and Key Personnel
 - 6.6 Export Control Compliance

RFPI Agreement (to be signed and returned with each Proposal - see Page 12)

USABC DEVELOPMENT OF AN AUTOMOTIVE PERFORMANCE GRADE CELL USING RECOVERED ACTIVE MATERIALS FROM END OF VEHICLE LIFE Li-ION BATTERIES

REQUEST FOR PROPOSAL INFORMATION (RFPI)

1.0 Statement of Purpose/Objectives

The United States Advanced Battery Consortium LLC (USABC), an organization whose members are FCA US LLC, Ford Motor Company and, General Motors defines and conducts pre-competitive, vehicle-related research and development (R&D) in advanced battery technology. USABC has carried out a number of battery development programs, focusing on low-cost, long-life, high-energy, high-power technologies. The overall objective of this RFPI is to challenge the existing recycling business model and innovate towards a value driven, self-sustaining model for large format lithium ion batteries.

The USABC, in recognition of the importance of lifecycle management for advanced batteries, intends to develop opportunities to encourage reuse of used active battery materials back into new battery systems to 1.) Lower total life cycle costs of battery systems and 2.) Increase the residual value of end of life battery systems. Several demonstration projects have shown the ability to recover active materials from used lithium-ion cells and create new cells with the recovered material demonstrating good capacity and cycling capabilities. USABC would like to evaluate a cell developed using a substantial quantity of recovered materials against USABC goals.

The purpose of this RFPI is to identify single developers or collaborative teams having Lithium-ion cell recycling technologies and the ability to incorporate recovered active materials in a Lithium-ion cell capable of meeting or approaching USABC goals for HEV, PHEV or EV as listed on USABC's Website (http://www.uscar.org/guest/article_view.php?articles_id=85). The intended R&D approach of this subcontract is to develop an advanced lithium-ion cell with a meaningful (reference section 6.2) portion of the active materials reclaimed and reused from end of life hybrid/electric vehicle cells. (Note: USABC is not interested in proposals using recovered materials from lithium cells which currently have high recycling material values such as Lithium Cobalt Oxide (LCO) cells.) The USABC expects that this work will be partially funded by the US Department of Energy through a cooperative agreement awarded to the USABC.

If the developer believes that their proposal would be strengthened and could more likely meet the requirements through strategic collaboration with other partners, a broader team-oriented proposal can also be submitted. (Developer and partners can refer in this case to: recycler, cell developer, material developer etc.)

Although project goals can be set that approach but not meet all of the USABC goals, a credible plan toward achieving all the USABC goals must be provided. The goals assume a development

timeframe which would culminate in recycling technology commercialization by calendar year 2020 to 2025, as detailed in Section 6.2. If the applicable USABC goals are not achievable, but a credible business case exists for these batteries to be used in alternate applications, please provide a description of the intended application and supporting business case. Proposals with a plan for meeting USABC cell/system performance goals however, will be given preference in the rankings over those with alternative business cases. All proposals, regardless of application, will be evaluated using standard USABC test procedures.

2.0 Business Objectives

This USABC RFPI represents a unique opportunity for developers to leverage their resources in combination with those of the automotive industry and the federal government. For the auto makers, this type of pre-competitive cooperation minimizes duplication of effort and risk of failure, and maximizes the benefits to the public of the government funds.

Beyond the efficient and timely usage of resources, the auto makers recognize that successful commercialization of these technologies will only be completed when a supplier base has been established for the selected components and subsystems. It is, therefore, a major business objective of USABC to enhance a supplier base as the development progresses. All developers submitting proposals will be requested to demonstrate that they have the potential to develop a commercially viable business, which can produce sufficient volumes to meet automotive requirements, and provide engineering and testing support to meet automotive implementation requirements. Research and other organizations with current, direct affiliations with businesses that derive a majority of their income from related product sales, will also be considered. At the time of submittal, all developers will be required to have demonstration hardware and test results available for USABC inspection. Testing performed in accordance with the USABC battery test procedures is preferred, however not mandatory. Inspection and testing of samples by the USABC may be included in the selection process. Developers who do not have test results available for examination by USABC at the time of submittal need not respond. Proposals should be meaningfully different from other proposals previously offered to USABC.

3.0 Developmental Timing

The proposals must be accompanied by a development time chart specifying the following:

1. Length of time the technology has been under development by the developer;
2. Projected length of time remaining to full scale availability; and
3. Projected time line for commercialization, including any preproduction phases that may be planned.

4.0 Business Case

The submittal must be accompanied by a business case, divided into two sections. The first section shall state the cost assumptions used that will lead to the cost targets listed. These assumptions should be in general terms, broken down by major components, including material cost, processing cost and other costs. These costs should be presented in sufficient detail such that they can be used by the USABC to build confidence that its cost targets can be met by the proposed technology.

The second portion of the business case should address the anticipated capital investment required to support this initial program investment, including anticipated non-EV markets for the technology, sources of capital, etc. A copy of the USABC cost model, which is a multi-stage spreadsheet, is available on the USABC website:

http://www.uscar.org/guest/article_view.php?articles_id=143.

Please note that USABC will not provide funding for capital expenses.

5.0 Technical Challenges

Proposals must be accompanied by a clear description of the remaining technical and other challenges that the developer still needs to meet in order to commercialize the proposed technology and meet USABC's long-term criteria. A narration of the technical challenges that have already been met in order to reach the present state of development will also be useful. Any testing, by USABC, of pre-contract demonstration hardware will be done in accordance with the USABC battery test procedures. These procedures can be found on the USABC website, http://www.uscar.org/guest/article_view.php?articles_id=86.

6.0 Information Requested

The information USABC is requesting from interested parties is specified in the following subsections. It includes: (1) a brief description of your company(s) background; (2) a description of the recycling technology being proposed, including the recycling process description to support high volume active material production; (3) a description of the targeted application for new cells; (4) a description of the developed cell's chemistry; (5) a description of the recommended characterization techniques to verify the quality of the reclaimed materials; (6) the development plan for incorporating recycled active materials into the cell technology and a description of the percent of recycled content planned for cell technology; (7) the proposed program deliverables, timing, and cost-share; (8) any formal or informal teaming/partnership arrangements planned, and (9) acknowledgement of export control compliance. Note that the ultimate testing and technology demonstration of the cell technology must occur in cell formats and sizes of automotive interest. If non-automotive application is targeted, the cell format may match the intended target application. In such cases, the application and targeted cell size must be documented in the information requested. We encourage demonstration cell formats of 2.0 Ahr or greater regardless of application. Relevant information regarding USABC performance targets can be found on the USCAR website, at

<http://www.uscar.org/guest/teams/12/U-S-Advanced-Battery-Consortium-LLC>.

USABC does not expect to award contracts on the sole basis of responses to this RFPI. All responses will be considered by representatives of the partners and other participants, and will be ranked according to their merit. The submitters of the most promising proposals will be contacted by USABC to enter into negotiations which may lead to firm contractual arrangements. If the government and other funding become available, as now expected, USABC intends to award one or more development contracts. However, nothing herein should be interpreted as a commitment to award a contract.

The information requested below should be answered as thoroughly as possible within a maximum of twenty five pages, in total, for the response to the RFPI. Your submission package should be sent via electronic mail and shall contain a cover letter, a complete copy of your proposal and, a signed copy of the RFPI Agreement. All technical and financial material submitted to the USABC must be in the English language. If you have any questions concerning the RFPI, please contact Renata Arsenault @ (313) 805-5133 or Maureen LaHote @ (313) 910-3720.

NOTWITHSTANDING PROPOSER'S MARKINGS TO THE CONTRARY, ALL INFORMATION SUBMITTED IN RESPONSE TO THIS USABC RFPI SHALL BE TREATED ON A NON-CONFIDENTIAL BASIS.

ALL PROPOSALS ARE TO BE SUBMITTED TO THE CONSORTIUM IN ACCORDANCE WITH THE ATTACHED RFPI AGREEMENT WHICH MUST BE EXECUTED WITHOUT MODIFICATION AND ACCOMPANY THE PROPOSAL. NO PROPOSAL SHALL BE EVALUATED BY THE CONSORTIUM WITHOUT PRIOR EXECUTION OF SUCH RFPI AGREEMENT.

SEND, VIA ELECTRONIC MAIL, YOUR PROPOSAL (including signed RFPI Agreement) TO:

**Maureen LaHote
Business Manager
United States Advanced Battery Consortium
E-mail: mlahote@uscar.org**

6.1 Company Background

In order to become more familiar with your company(s), the USABC needs background information about your business. If your proposal is for a team, furnish the requested information for each company that makes up your team. Please answer/furnish the following information:

- Describe your company's structure, ownership, product lines, and customer base, including domestic and foreign facilities for research and production.

- Please describe how previous R&D successes (especially with USABC or DOE) have been incorporated into the current proposal.
- Please describe the company's experience (if any) in the recycling of used battery materials and cell development.
- If publicly owned, include the last 3 years of annual financial statements. Also include your most recent 10k, and 10Q Reports. If privately held, include the last 3 years of Balance Sheets, Income Statements, and a Sources & Uses of Funds Statement.
- Enclose a copy of your company's Business Plan for areas related to electrochemical energy storage technology and/or active material recycling.
- Describe the resources (headcount, expenses, and facilities) devoted to electrochemical energy storage and recycling technology development for the previous three years, currently, and forecasted through the expected project period of performance.
- Describe the modeling methods your company uses to estimate costs at sales volumes listed in the respective USABC goals for either HEV, PHEV or EV as listed on USABC's Website (http://www.uscar.org/guest/article_view.php?articles_id=85).
- Do you currently hold any licenses and/or patents or pending patent applications for advanced electrochemical energy storage technology, manufacturing processes, or recycling processes? If so, please describe. Are there any restrictions on licensing this technology?
- Provide any projections on potential production for the proposed technology. Also, describe key technical innovations that could lead to high performance and cost effective electrochemical energy storage subsystems.
- Provide a brief resume on key personnel to be dedicated to the project.

6.2 Proposed Cell Technology

The proposed cell technology should contain a substantial amount of recovered cathode material recovered from end of life lithium-ion cells while still meeting the targets for either HEV, PHEV or EV as listed on USABC's Website (http://www.uscar.org/guest/article_view.php?articles_id=85). A blended cell utilizing recovered cathode content up to 100% recovered cathode, but not less than 15% is acceptable. Other recovered materials may be used in the cell as well.

A thorough technical review of each proposed technology is required prior to the award of any contract for development. In preparing a reply to the RFPI please provide a response to each of the following points.

- Provide a brief technical description of the proposed recycling and cell technology that will meet the characteristics listed in the Appendix, including descriptions of the recovered materials reused in the cell and percentage of the reused materials by cell component. The description should include information on the cell chemistry(s) and target application(s).
- Provide a plan to obtain aged or end of life vehicle battery cells and characterize their State of Health (SOH) prior to recovery and reuse of cell materials.
- Summarize the present status of the proposed technology, with experimental data and test methods used to acquire the data, including:
 - Physical, performance, and life characteristics of all relevant formulations developed and tested at your facilities, or at independent test facilities.
 - Any environmental, health, safety or permitting issues relating to manufacturing, recycling, use and disposal of the proposed technology.
 - Dominant failure mechanisms that limit the operating life of lithium-ion batteries using this technology, and use restrictions desired/required to maximize the life of the subsystem.
- The characteristics of the current technology by using the table provided in the Appendix.
- Provide any relevant quality-related metrics.

6.3 Proposed Technology Development Plan

Propose how the technology would be developed to meet the USABC technical criteria including:

- Barriers that must be overcome (should be closely based on the objectives listed for either HEV, PHEV or EV programs as listed on USABC's Website (http://www.uscar.org/guest/article_view.php?articles_id=85).
- Task objectives needed to overcome the barriers, approaches, success criteria, and demonstration tests (A work breakdown structure is helpful but not required.);
 - Comparison of the recovered materials performance vs. baseline (virgin) material including specific capacities, cycling data, and HPPC. The proposal must provide a

plan for testing the cells with recycled material against those with virgin material, to ensure that any observed differences can be directly attributed to only the recycled content and not to differences in cell fabrication.

- The project plan should include a design of experiments with different levels of recycled material substitutions. Over the course of the project, one of the key learnings sought is identifying the limits beyond which unacceptable performance or life trade-offs are encountered that negate any cost reduction benefits. The final recommended percentage of recycled material will be used in the program deliverables and all cost and business model projections will reflect this number.
- Feasibility and scale-up issues that must be resolved; and
- Transition from feasibility demonstration to prototype hardware.

Separately propose how the technology could be produced in high volume. Define the raw materials, processes, capital equipment, and labor required at the desired production levels. Discuss the overall timing required to achieve initial production, including prove-out. Define any intermediate steps required to reach initial rated production including pilot plants, technical challenges regarding the manufacturing process, and their time frame.

Define any additional technical issues, and their possible resolution, concerning the proposed technology relevant to vehicle applications. Propose a warranty structure for the developed cell corresponding to the initial commercial production level.

Provide a projected cost breakdown of the proposed technology, including costs projected for the desired production volumes. Costs related to warranty and/or replacement, and recycling should be clearly indicated. The manner in which the projected costs, volumes and time schedules are expected to be achieved should also be provided.

6.4 Proposed Program Schedule, Deliverables, Cost, and Cost Sharing

Developers must clearly identify their milestone objectives. The setting of major milestones and timing will be reviewed and agreed upon between each USABC Work Group and the corresponding subsystem developer/supplier team. It is anticipated that there will be intensive interaction between both parties in setting program milestones. The involvement of all team member organizations in the setting of program milestones is strongly encouraged.

The delivery of cell samples for testing and evaluation will be established with the selected developer(s) and the USABC Work Group. The evaluation of deliverable cell samples will be undertaken at several testing facilities, such as the various National Laboratories and other USABC partners. The cell test schedule will be agreed upon by the USABC Work Group, the developer, and the test facilities.

It is expected that material hardware deliverables will be used to demonstrate and evaluate the performance of the recovered materials in a viable cell of 2 Ah size or larger. Developers who do not have the experience or capability to make the agreed upon number of viable cells are required to find partners with a proven track record of producing commercial Li-ion batteries. The USABC can, upon request, provide a list of cell manufacturers who have previously performed development programs with USABC. A partnership between a recycler and a cell fabricator with a proven track record will be given preference in the rankings of proposals.

The USABC is interested in advancing the development of commercially viable energy storage products, and prefers to focus on technologies, including cell chemistries, that are most likely to achieve commercial success in the near term. The current cell chemistry of particular interest is a NMC cathode paired with a graphite anode, although other chemistries may be proposed and/or selected. The preferred positive electrode for high-voltage cells, is LNMO spinel, paired with a graphite negative electrode. The developer should be able to clearly explain the rationale behind the selection of battery couples other than NMC/graphite or LNMO/graphite. The developer must clearly identify the cell to be delivered. The details should include the intended electrodes, separator, electrolyte package, the size and format of the cell, and where they will be built. The goals listed on USABC's Website (http://www.uscar.org/guest/article_view.php?articles_id=85) represent the minimum required values which every program must achieve, unless specifically stated otherwise.

All Developers are expected to contribute or cost share in the developmental costs. The Developer should submit proposals indicating cost sharing as a percentage of the total proposed program development amount. The extent of cost sharing may be negotiated between USABC and the development team, taking into consideration whether the company is domestic, foreign, or foreign controlled, rights to license background and foreground technology, benefits to US economy, and other factors. However, a minimum of 50 percent developer cost share is contractually required. The Developer will agree that at least 75% of the direct labor billed to the USABC for this project will be incurred within the United States.

The proposer shall provide cost breakdown between labor, materials, indirect costs, etc. and a separate analysis of total costs for each major task. The tasks that each subcontractor will complete and the funding they will receive should be clearly indicated in the cost breakdown.

Contractors will provide written quarterly reports to USABC, including test data and development progress. Additional reporting (i.e., oral) will be scheduled with the USABC Work Group. A final written report will be submitted to USABC at the end of the contract period.

6.5 Cooperative Relationships

The proposal should indicate any additional resources that may be required beyond those of the contractor to achieve program goals. This would include the development of cooperative relationships between component developers, component manufacturers, and subsystem

integrators. Other cooperative relationships could involve National Laboratories or Universities for materials research, test facility development, test and analytical procedures, or other techniques available only at specialized locations.

6.6 Export Control Compliance

The proposer will be required to acknowledge that export control rules limit or prohibit the transfer of covered technology to foreign nationals and agrees to establish and maintain internal controls and procedures adequate to insure accurate determination by the proposer of whether and when its technology falls within the ranges and definitions of the currently effective export control regime.

RFPI AGREEMENT

NOTWITHSTANDING PROPOSER'S MARKINGS TO THE CONTRARY, ALL INFORMATION SUBMITTED IN RESPONSE TO A UNITED STATES ADVANCED BATTERY CONSORTIUM (USABC) REQUEST FOR PROPOSAL INFORMATION (RFPI) SHALL BE TREATED ON A NON-CONFIDENTIAL BASIS.

AGREED:

BY _____

TITLE _____

PROPOSER _____

DATE _____

APPENDIX

Proposed Cell Attributes

Cell Level Attributes (supplied by developer)	Units	Current State (baseline)	End of Program Target
List Target USABC HEV/EV/PHEV Program			
Cell Capacity (1-C discharge)	Ah		
Cell Volume (without terminals/tabs)	Liter		
Cell Mass	g		
Vmin continuous, V max continuous (0 and 100% SOC)	V, V		
Vmin pulse - V max pulse	V, V		
Vnominal	V		
Cost: Energy (basis: usable energy)	\$/Wh		
Cell format	can/pouch		
Cell dimensions: (height x width x thickness)	mmxmmxmm		
Recovered active materials in cathode	%		
Total recovered materials in cell	%		
Proposed Architecture to Achieve System Targets			
Battery Size Factor (BSF)	#		
Parallel-Series Configuration	_p_s		

i Values correspond to Beginning-of-Life (BOL)