



Informational Webinar about
Lithium-Ion Battery Recycling Prize

April 10, 2019

Disclaimer: All details necessary to participate in the Lithium-Ion Battery Recycling Prize program are provided in the Official Rules document online. The information provided in this presentation is not intended to amend, modify or substitute details provided in the Official Rules. Information presented should be used in conjunction with the Official Rules. In addition, any reference in presentation to any specific commercial product, process, or service, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement, recommendation, or preference by the U.S. Department of Energy. Visit americanmadechallenges.org



U.S. DEPARTMENT OF ENERGY

Introductions



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Data Analytics Tools
& Applications

Outline

- **Background**
 - DOE Critical Materials Research Directions for Lithium-Ion Batteries
- **About the Prize**
 - Prize Goals and Progressive Phases
 - Phase 1 Submission Tracks
 - Phase I Timeline
 - What to Submit
 - Evaluation of Submissions
 - Eligibility
 - Registration Demo
- **Questions**

Background



U.S. DEPARTMENT OF ENERGY

Energy Secretary Rick Perry Announces the Battery Recycling Prize



January 17, 2019 at the Bipartisan Policy Center's American Energy Innovation Council

"America's dependence on foreign sources of critical materials undermines our energy security and national security ..."

"DOE will leverage the power of competition and the resources of the private sector, universities, and the National Laboratories to develop innovative recycling technologies, which will bolster economic growth, strengthen our energy security, and improve the environment."

The Battery Recycling Prize will encourage American entrepreneurs to find innovative solutions to collecting, storing, and transporting discarded lithium-ion batteries for eventual recycling.



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A \$5.5 million phased competition over three years

- **Funded by the DOE's Vehicle Technologies Office (VTO) and DOE's Advanced Manufacturing Office (AMO)**
 - Dave Howell, VTO Acting Office Director
 - Samm Gillard, VTO Technology Development Manager
 - Michael McKittrick, AMO R&D Consortia Program Lead
- **Administered by the National Renewable Energy Laboratory (NREL)**
 - Ahmad Pesaran, Technical Program Manager

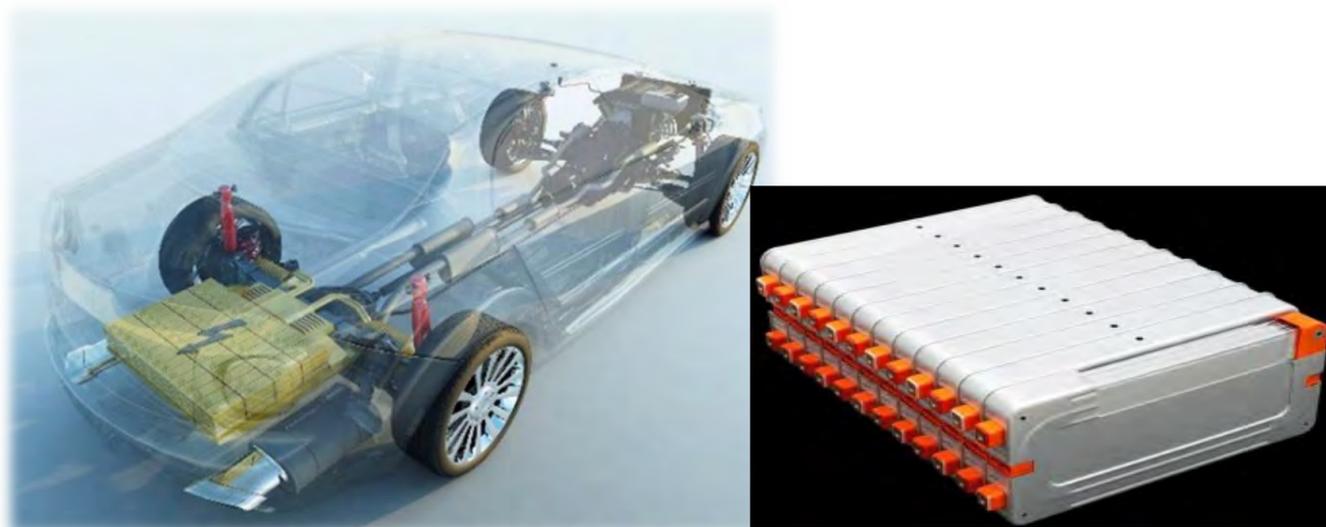
About VTO and AMO

VTO develops advanced transportation technologies that:

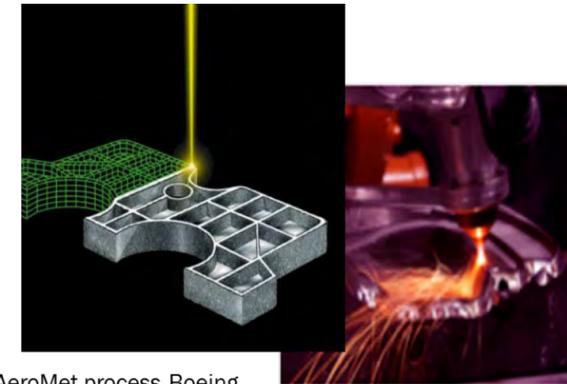


- ✓ Improve U.S. transportation sector energy **efficiency**
- ✓ Increase domestic energy **security** through fuel diversification
- ✓ Reduce operating **costs** for consumers & business

Significant Battery & Electrification R&D



AMO develops advanced manufacturing technologies that:



AeroMet process Boeing, Northrup Grumman, NavAir
POM laser processing AM equipment

- ✓ Drive U.S. global manufacturing leadership and economic competitiveness
- ✓ Improve energy productivity and manufacturing sustainability
- ✓ Reduce **costs** for consumers & business



Critical Materials Institute
AN ENERGY INNOVATION HUB



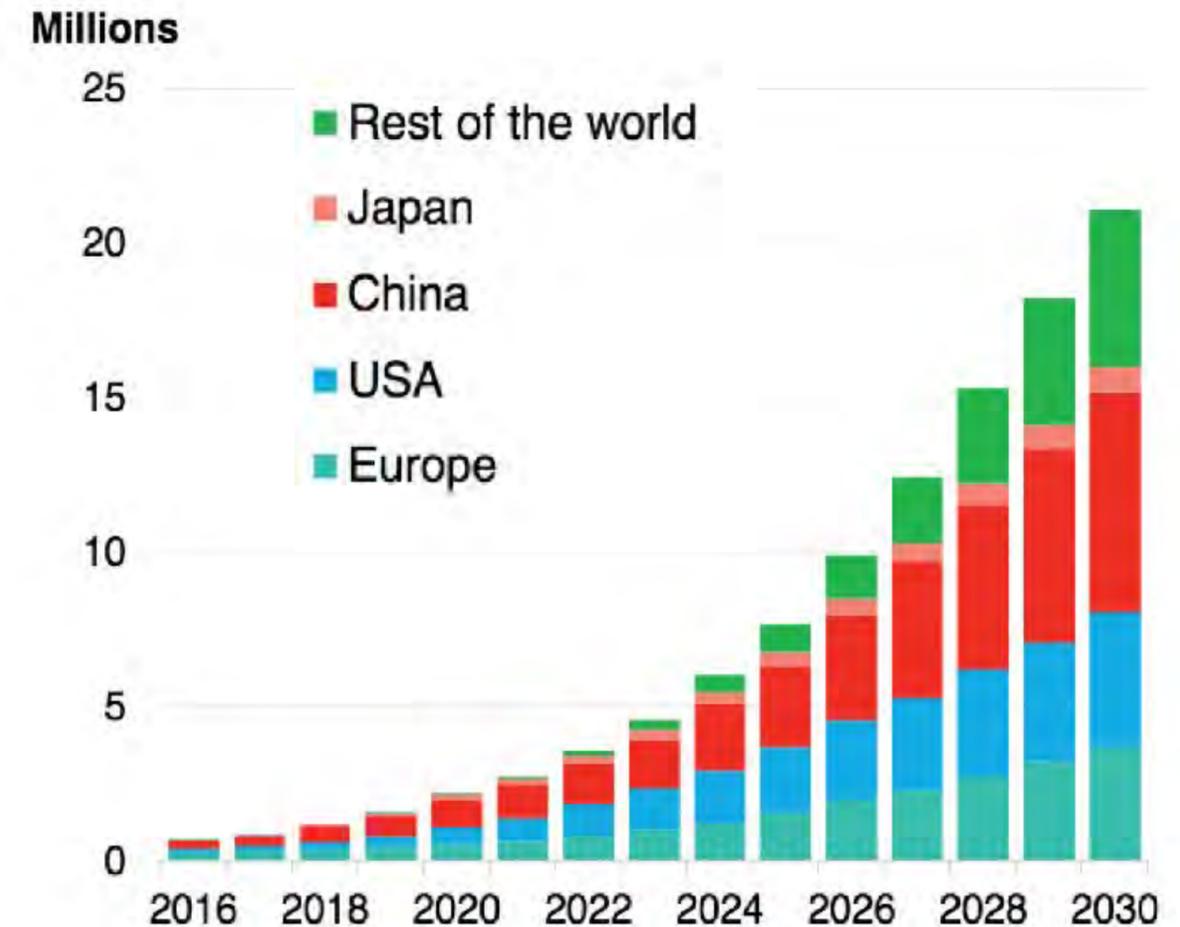
Light-Duty Passenger Vehicle Market and Potential Growth

Plug-In Electric Vehicle (PEV) Sales in USA

- **361,315** PEVs Sold in USA in 2018
 - **85%** growth from 2017
- **41** PEV Models Available
- **1,117,788** PEVs have been sold in USA since 2011

Global EV Forecast

Source: Bloomberg New Energy Finance



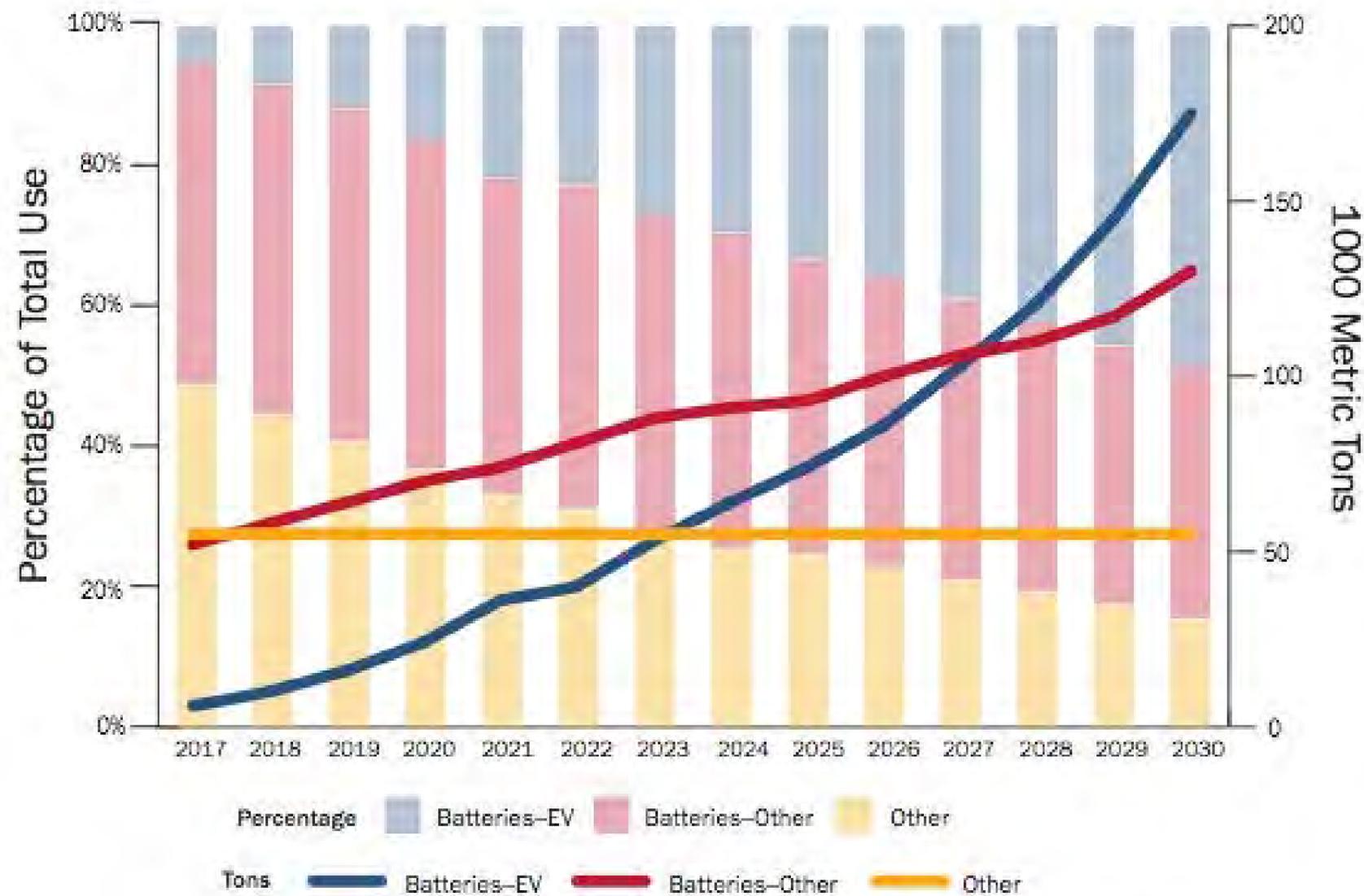
Battery electric vehicles forecasted to achieve more than 20 million sales globally by 2030

Global Cobalt Demand Forecast

- Cobalt is considered the highest material supply risk for EVs
- Demand from EV market is projected to dominate as early as 2027
- Other materials have potential shortages but are not earth abundance issues

Forecasted Global Cobalt Demand by End-Use

Source: NREL analysis of Bloomberg New Energy Finance, 2018*



*<https://www.bloomberg.com/news/articles/2018-06-10/cobalt-battery-boom-wavers-as-china-demand-lull-brings-out-bears>

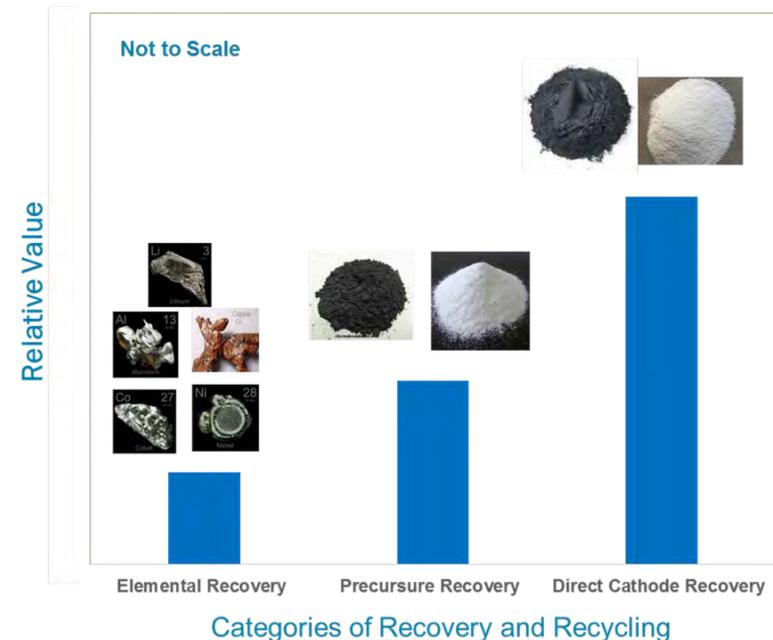
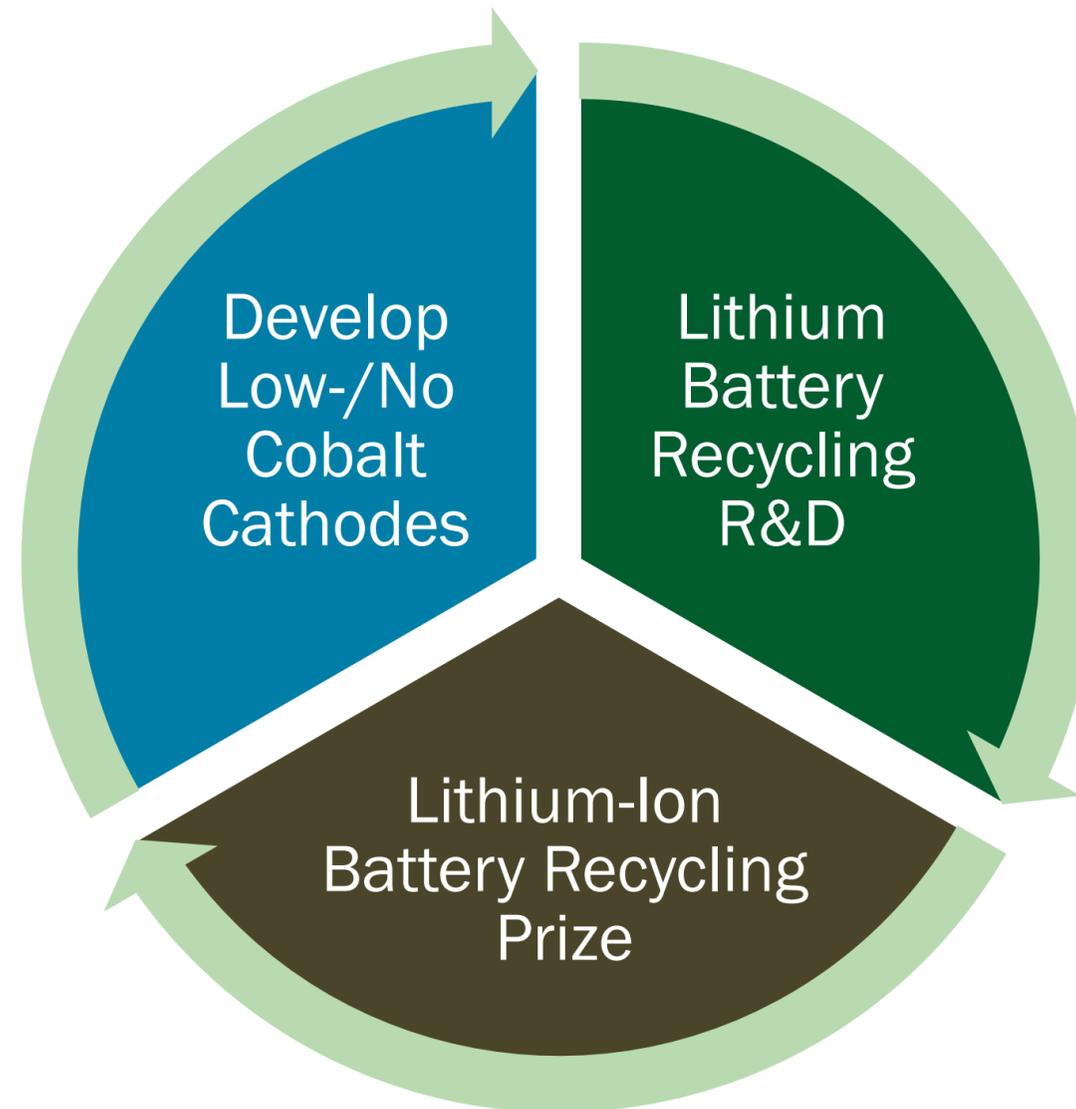
DOE Strategic Objective for Electric Vehicle Battery Storage

By September 30, 2022

- Reduce the cost of EV battery packs to less than \$150/kWh (long-term goal is \$80/kWh)
- Significantly reduce or eliminate the dependency on critical materials
- Utilize recycled material feedstocks



Cobalt (CO) Content (kg) per 100 kWh battery pack	NMC622	19
	Low-no CO target	< 5 or Zero



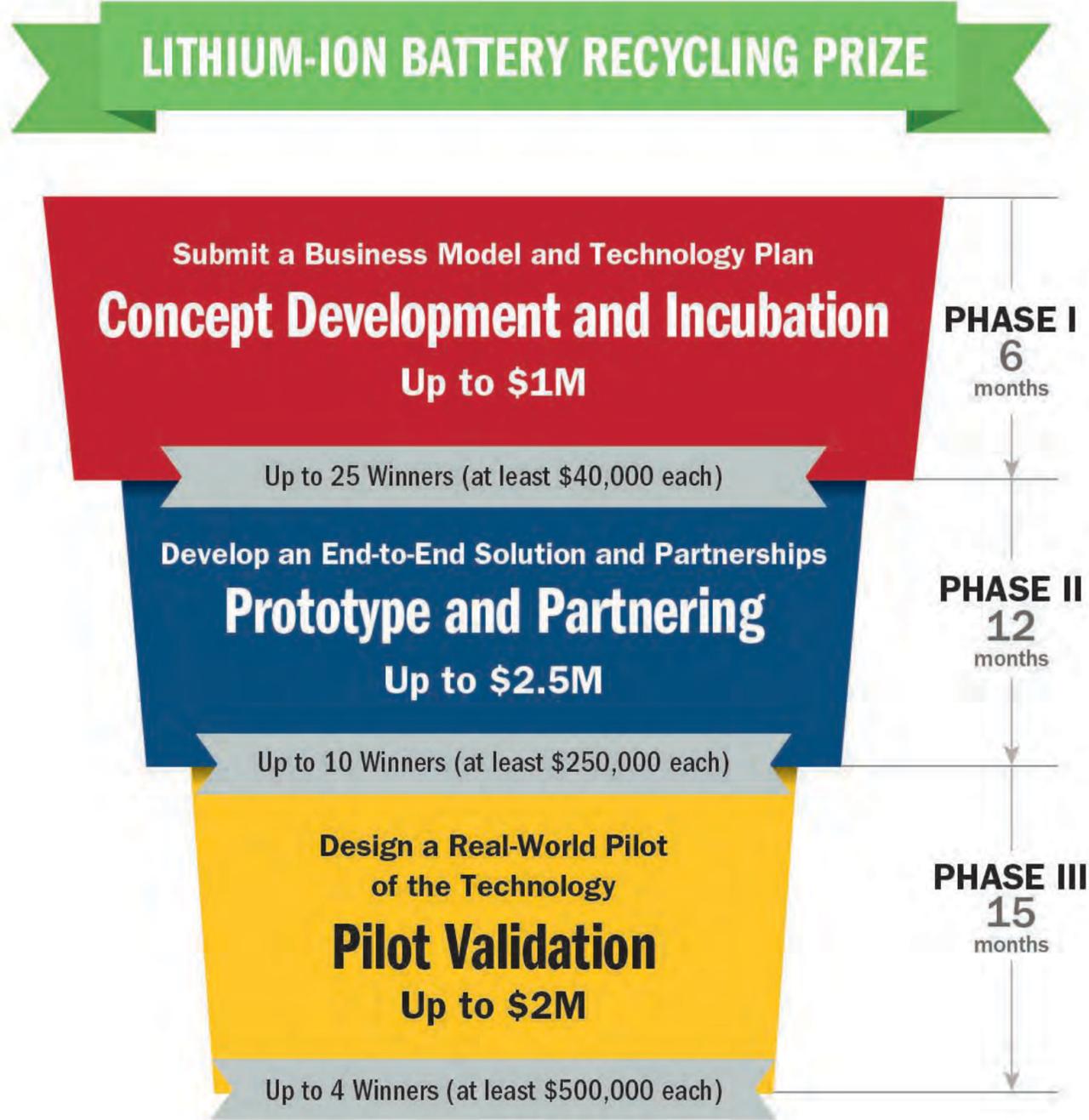
Battery Recycling Prize

Innovative Ideas for Collection, Sorting, Storing, and Transporting Discarded Li-Ion Batteries

PRIZE GOAL

Demonstrate a process that has the potential to capture 90% of ALL lithium-based battery technology in the U.S. (when scaled), including consumer electronics, stationary, and transportation applications.

Prize will be administered on the HeroX platform <https://www.herox.com/BatteryRecyclingPrize>



Prize Components



U.S. DEPARTMENT OF ENERGY

Goals of the Prize

- Develop and demonstrate processes that, when scaled, have the potential to profitably **recover 90% of all lithium-ion battery technologies** in the U.S.
 - Covering consumer electronics, grid, industrial, and transportation applications.
- Energize American ingenuity to innovate technologies and processes to collect, sort, store, and transport spent lithium-ion batteries for eventual recycling and material recovery.
- Empower innovators and private entities to rapidly transform ideas into prototypes and pilot demonstration for attracting investment for scale-up and commercialization.

The Three Phases of the Prize

PHASE I (\$1M)

Concept Development and Incubation

- Register now to compete!
- Concept papers to outline plan
- Submissions due August 1, 2019
- Form teams and incubate and improve concepts
- Up to 25 winners

Up to \$1,000,000 distributed equally among the winners in cash prizes (minimum of \$40,000; maximum of \$200,000 per winner)

6 Months

PHASE II (\$2.5M)

Prototype and Partnering

- Simulate, verify, and validate concepts and processes
- Partner with stakeholders
- Up to 10 winners

Up to \$2,500,000 distributed equally among the winners in cash prizes (minimum of \$250,000; maximum of \$500,000 per winner)

12 Months

PHASE III (\$2M)

Pilot Validation

- Build your battery recycling business model and demonstrate process
- Visit by DOE, industry, and stakeholder before the end of phase III
- Up to 4 winners

Up to \$2,000,000 distributed equally among the winners in cash prizes (minimum of \$500,000; maximum of \$1,000,000 per winner)

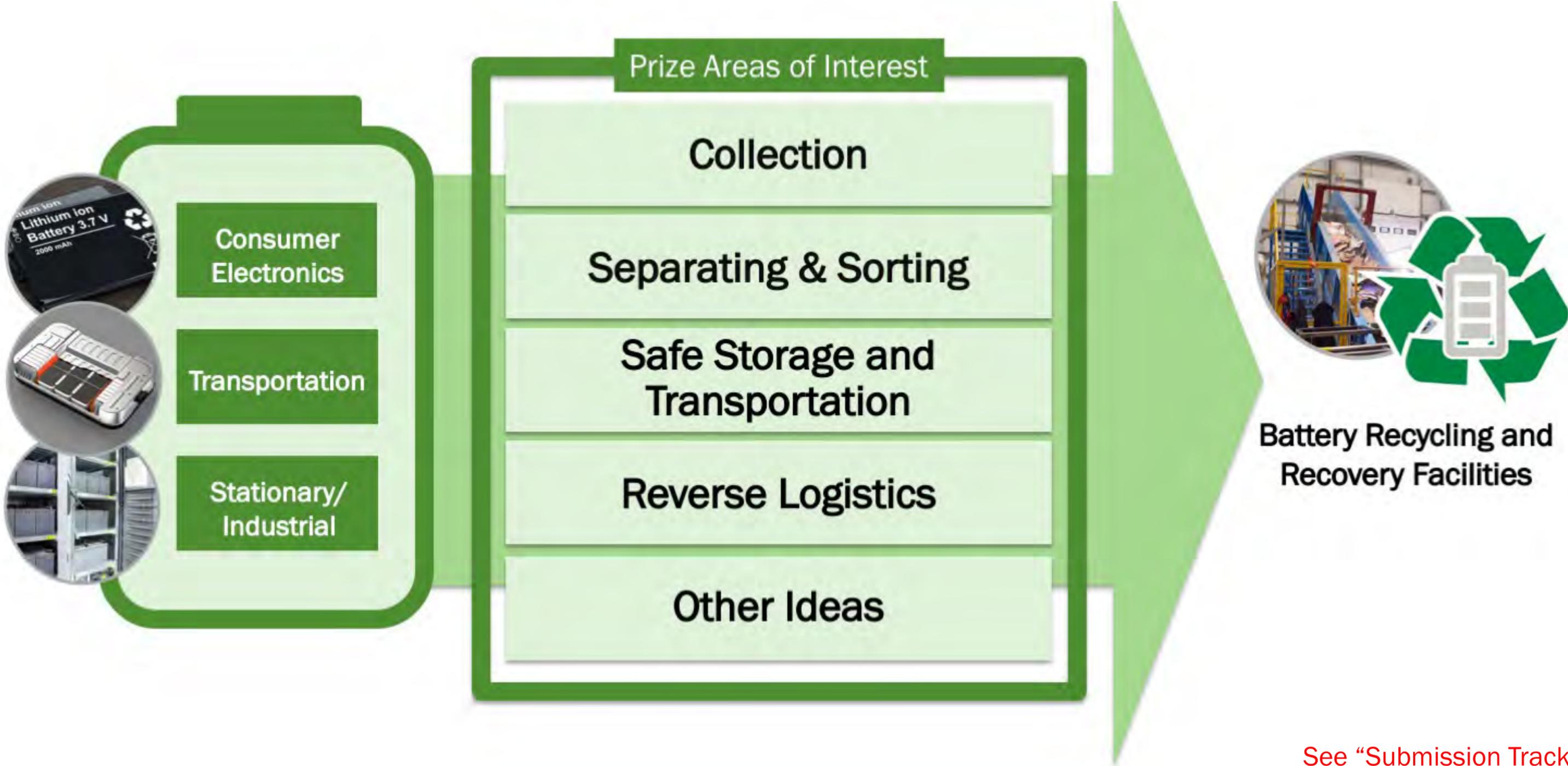
15 Months

\$

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Phase I Tracks of Interests



See “Submission Tracks”
in Rules

Track 1: Collection

- **Expected Outcome:** Develop a system or systems to significantly increase the volume of lithium-ion batteries collected.
 - What is your strategy to collect lithium-ion batteries?
 - How does your solution motivate the public to increase the rate of lithium-ion recycling?
 - Is your solution a local, regional, or national solution? Can it be scaled to collect 90% of lithium-ion batteries in the U.S.?
 - How broad is your solution? Does it cover strategies to collect lithium-ion battery types, including automotive, other large-format, and consumer electronics?



See “Submission Tracks”
in Rules

Track 2: Separation and Sorting

- **Expected Outcome:** Create a system or systems to make sorting and separation of different lithium-ion battery types and chemistries more effective (faster, more accurate, cheaper) than current practices.
 - How are you sorting and separating? Are you using machine vision, x-rays, induced magnetic fields, or some other method?
 - If and how does your technology identify different lithium-ion battery cathode chemistries?
 - Is your technology destructive or non-destructive?
 - How quickly can your solution perform the separation?
 - How does it scale?

See “Submission Tracks”
in Rules

Track 3: Safe Storage and Transportation

- **Expected Outcome:** Develop cost-effective solutions that could render batteries safe or inert during storage and shipping for further downstream processing.
 - How does your solution reduce or eliminate the potential environmental and/or safety hazards?
 - Does your solution mitigate any potential thermal event?
 - How does your solution address Department of Transportation regulations?
 - Is it a physical, chemical, or design solution?
 - How does it scale?
 - What are the economics of your solution?

See “Submission Tracks”
in Rules

Track 4: Reverse Logistics

- **Expected Outcome:** Conceive solutions that minimize the cost of moving batteries out of end users' hands to recycling facilities, smooth the recycling supply chain, and anticipate the flow of materials.
- Is your solution a specific algorithm, network design, model, or physical technology?
- How does your solution handle facility siting decisions (e.g., location of collection, temporary storage, recycling center)?
- How does your solution anticipate material (i.e., batteries) flows?
- How does your solution manage variable material flows over time?
- What does your solution assume about supply and demand, prices and costs, and sequence of collection, sorting, and safety solutions?
- What drives the efficiency of your solution? Is it mostly a function of siting decisions, vehicle routing optimization, management of stocks and flows, or some other lever?

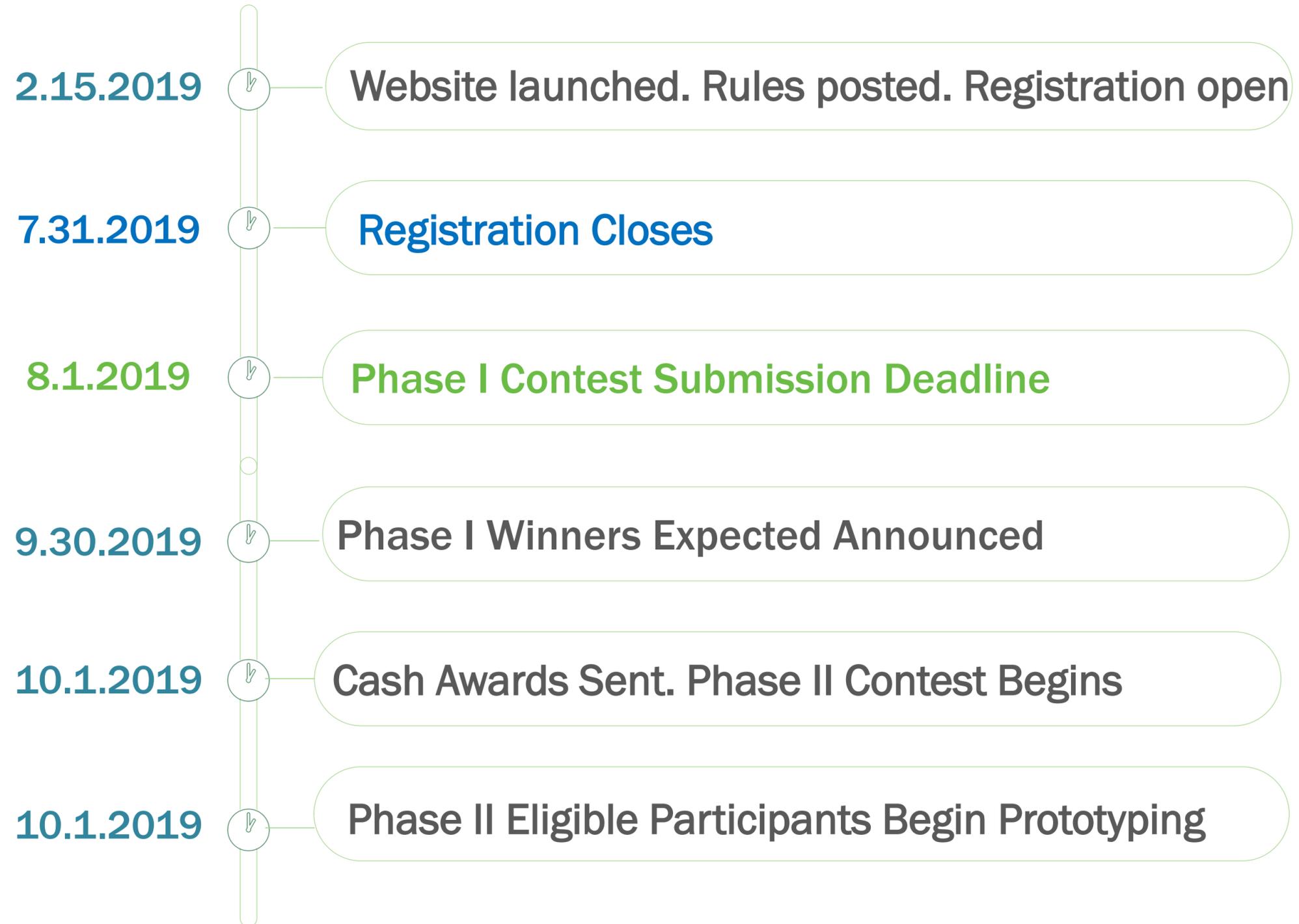
See “Submission Tracks”
in Rules

Track 5: Other Ideas

- **Expected Outcome:** Formulate radical ideas or solutions not otherwise addressed in the other tracks that meet the goal of the prize while spurring market innovation.
 - Does your solution not fit into any of the boxes described? What didn't we think of?
 - Describe your idea considering the relevant questions posed in the previous tracks.

See “Submission Tracks” in Rules

Important Dates in 2019



See “Important Dates” in Rules

What To Submit for Phase I

- **Video: A 90-second (maximum) video showcasing the submission (PUBLIC)**
 - Video is a non-scored item but will be required for submission
 - Video should be informative to what your solution will address
 - Have fun with it, but don't spend too much time on it.

Templates and file naming could be found in (<https://www.herox.com/BatteryRecyclingPrize>). Submit separate unlocked PDF files.

What To Submit for Phase I

- **Cover Page:** Name, Primary Submitter, Title, Address, Submission Track, Abstract (**PUBLIC**)



The image shows a screenshot of a web form titled "Cover Page Title Sheet" for the U.S. Department of Energy Lithium-Ion Battery Recycling Prize. The form is set against a light blue background with a green horizontal bar at the top. The top left of the form contains the text "U.S. Department of Energy" and "LITHIUM-ION BATTERY RECYCLING PRIZE". The top right features a circular logo with a gear-like border, containing the text "AMERICAN MADE" and "BATTERY RECYCLING PRIZE". Below the logo is the U.S. Department of Energy seal. The form itself is white and contains several fields with labels and instructions:

- Cover Page Title Sheet**
- Team Name:** Enter Team Name
- Primary Submitter:** Enter Team Leader Name
- Address:** Enter Address
- Member Names:** Enter Team Member Names
- Submission Title:** Enter Submission Title
- Submission Track:** Enter Submission Track
- Abstract:** (<100 Words)

Templates and file naming could be found in (<https://www.herox.com/BatteryRecyclingPrize>) Submit separate unlocked PDF files.

What To Submit for Phase I

- Summary Slide: Title, Primary Submitter, Submission Track, Concept, Approach, Impact **(PUBLIC)**

The image shows a submission form for the U.S. Department of Energy Lithium-Ion Battery Recycling Prize. The form has a blue header with the text "U.S. Department of Energy" and "LITHIUM-ION BATTERY RECYCLING PRIZE". On the right side of the header is a logo that says "AMERICAN MADE BATTERY RECYCLING PRIZE" with a gear and stars. Below the header, there are several input fields for "Team Name:", "Primary Submitter (Team Leader Name):", "Address:", "Member Names", "Submission Title:", and "Submission Track:". Below these fields are three large boxes for "Concept", "Approach", and "Potential Impact". Each box contains a bullet point: "Please make any text readable in a standard printout and conference room projection." The U.S. Department of Energy logo is also present at the bottom right of the form area.

Templates and file naming could be found in (<https://www.herox.com/BatteryRecyclingPrize>) Submit separate unlocked PDF files.

What To Submit for Phase I

A 5-10 Page Proposal (May Contain Confidential Business Information)

- Executive Summary
- Team Composition and External Support
- Solution
- Market Validation and Analysis
- Planned Execution and Allocation of Funds
- Detailed Technical Explanation

See “What To Submit” in Rules

How Do We Score and Evaluate Each Submission?

- **Advisory Review:** Expert reviewers will score based on innovativeness, impact, feasibility, and technical approach. (Reviewers will sign Non-Disclosure Agreement and Certificate of Insurance).
- **Federal Consensus Panel:** After receiving reviews, a panel of federal experts will evaluate and make selection recommendations.
- **Selection Official:** Selection official will make final selections based on:
 1. Federal Consensus Panel recommendations,
 2. Advisory Review scores,
 3. Program Policy Factors (see [SECTION VI.14](#)).

Phase I Scoring

- **Innovativeness (35%)**

- How unique and novel is your idea?
- Does the applicant explain and capture the current state of the art?

- **Impact (25%)**

- If successful, how transformative is your solution to the market?
- Can you quantify how you will validate your solution?

- **Feasibility (25%)**

- How credible is your approach?
- What is the validation plan?
- Does the team have the right experience and equipment?
- Has the team identified potential risks and mitigation strategies in their approach?

- **Technical Approach (15%)**

- Does your solution use sound scientific principles?

Who is Eligible to Win?

- Individual U.S. Citizens and Permanent Residents.
- Organizations incorporated and maintaining a primary place of business in the U.S.
- Activities that are described in and support the submission package must be performed in the United States.
- National lab employees may participate as private individuals and not competing in their official capacity.
- Federal employees and DOE support service contractors are not eligible
- Only Phase I winners may compete in Phase II.



Scientists



Business Owners



Students and Faculty



Anyone with a Big Idea

Summary of major rules. The participants must review and follow Official Prize Rules at <https://americanmadechallenges.org/batteryrecycling/battery-recycling-prize-rules-and-scoring-criteria.pdf>

Registration Demo

American-Made Challenges



3,363

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ACCEPT CHALLENGE

Lithium-Ion Battery Recycling Prize

Energy, Environment & Resources, Science, Technology

Identify innovative solutions for collecting, sorting, storing, and transporting spent lithium-ion batteries. [Read Overview...](#)

ACCEPT CHALLENGE

STAGE
Enter

\$5.5 million in total prizes

Time left to Enter

118 : 05 : 44 : 13
days hrs min sec

Overview

Guidelines

Timeline

Updates ¹

Forum ⁶

Community ¹¹⁴

Resources

FAQ

U.S. Department of Energy
LITHIUM-ION BATTERY RECYCLING PRIZE

Questions?

Email: BatteryRecyclingPrize@nrel.gov



www.americanmadechallenges.org/batteryrecycling