OAK RIDGE National Laboratory

Fiscal Year 2019 Advanced Vehicle Technologies Research Funding Opportunity Announcement

$59M total

Concept Papers: 5/1/2019 5:00 PM ET

Full Applications: 6/19/2019 5:00 PM ET

Anticipated award negotiations: September 2019

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U.S. DEPARTMENT OF ENERGY

Fiscal Year 2019 Advanced Vehicle Technologies Research Funding Opportunity Announcement
Funding Opportunity Announcement (FOA) Number: DE-FOA-0002014

- $59M total
- CFDA Number: 81.086
- FOA Issue Date: 4/3/2019
- Submission Deadline for Concept Papers: 5/1/2019 5:00 PM ET
- Anticipated Date of Concept Paper Notifications: 5/20/2019
- Submission Deadline for Full Applications: 6/19/2019 5:00 PM ET
- Anticipated Date for EERE Selection Notifications: August 2019
- Anticipated Timeframe for Award Negotiations September 2019

AOI Number	Area of Interest	Anticipated Minimum Award Size for Any One Individual Award (Fed Share)	Anticipated Maximum Award Size for Any One Individual Award (Fed Share)	Approximate Total Federal Funding Available for All Awards	DOE/NNSA FFRDC allowed as Recipient	DOE/NNSA FFRDC allowed as Subrecipient
1a	Development of Materials to Enable Solid State Batteries	$1M	$1M	$8.5M	No	No
1b	Solid State Battery Diagnostic Tool Development	$1M	$1M	$2M	No	No
1c	Solid State Battery Modeling Development	$1M	$1M	$2M	No	No
2	Electric Motor Research Increasing Power Density 8X	$500K	$700K	$3.5M	No	No
3	Energy Efficient Mobility Systems Research	$1.75M	$3.5M	$7M	No	Yes
4	Predictive Modeling Capabilities for the Co-Optimization of Fuels and Multi-mode (SI/CI) Engines	$875K	$1.75M	$3.5M	No	Yes
5	New Material and Engine Technologies for High Efficiency Powertrains	$3.75M	$7.5M	$15M	No	Yes
6a	Alternative Fuel Vehicles (AFVs) and Infrastructure for Resiliency and Emergency Preparedness	$750K	$1.5M	$1.5M	No	Yes
6b	New Mobility Services in Rural America	$500K	$1M	$3M	No	Yes
6c	Alternative Fuel (e.g. natural gas) Proof-of-Concept in New Communities and Fleets	$350K	$780K	$7M	No	Yes
6d	EV Data Collection	$2M	$2M	$4M	No	No
6e	Open Topic	$330K	$670K	$2M	No	Yes
	Total			**$59M**		

AOI 1 Solid state batteries

- Opportunities
  - Electrolytes non-flammable
  - More robust cell operation
  - Integration of metal anodes possible
- Challenges
  - Low conductivity
  - Poor voltage stability
  - Inadequate mechanical properties

Performance Targets

Energy Storage Performance Requirements	Cell Level Targets
Useable Specific Energy @ C/3	≥ 350Wh/kg
Calendar Life	15 Years
Cycle Life (C/3 deep discharge with <20% energy fade)	1,000
Cost	≤$100/kWh

AOI 1 Solid state batteries

Development of Materials to Enable Solid State Batteries

- New solid electrolytes that can promote uniform lithium plating and have high conductivity and low reactivity against lithium metal and against high voltage cathodes;
- New polymer electrolytes that have the potential to operate at room temperature and possess the mechanical properties to prevent dendrites;
- Novel architectures/cell designs to protect metallic lithium from dendrite formation;
- Novel approaches to integrate solid ion conductors into cathode materials that can result in low interfacial impedance; and
- New designs of the sulfur cathode host to achieve high sulfur loading (≥6 mg/cm2) good sulfur utilization, minimal polysulfide diffusion, and limited excess electrolyte (goal of electrolyte to sulfur ratio of 3 ml/mg).

Solid State Battery Diagnostic Tool Development

- research, develop, and demonstrate in-situ microscopy, spectroscopy, and associated ex situ tools capable of effectively predicting the physical and chemical changes of lithium-metal based battery components during charge and discharge
- Quantification of the chemo-mechanical effects that determine the formation of dendrites at the lithium metal/electrolyte interface; and
- Quantification of the impact on capability and cyclability due to examination of the cathode solid electrolyte interface (SEI) against a solid electrolyte.

Solid State Battery Modeling Development

- research, develop, and demonstrate advanced lithium-metal based battery models. Models should address electrochemical/chemical and transport processes (kinetics, thermodynamics, phase transitions, ion transport, etc.) that occur in a wide range of length and time scales
- Charge transfer at interfaces, with details on the reaction products and rates of competing reactions; and
- Lithium dendrite growth against solid electrolytes

AOI 2: Electric Motor Research Increasing Power Density 8X

- Support for Electric Drive Technologies Consortium with ORNL, NREL, SNL
- Printable magnetic materials for motors
- Covetic/Printed Steel
- Ultraconductors for Motor Windings
- Novel High-Power Density Non-Heavy Rare-Earth Motor Topologies for High Speed Traction Motors – High speed (>20,000rpm)

EDT Research Consortium Strategic Goal (compared to 2015 baseline)
A 125 kW electric traction drive system: • 8X power density improvement, or 1/10 the volume (33 kW/L) • 1/2 the cost ($6/kW) • 2 X useful life (300,000 miles) • 100 kW/L inverter and a >20,000 rpm, 50 kW/L electric motor

AOI 3: Energy Efficient Mobility Systems Research

- Connected and automated vehicle technologies
  - Potential to significantly improve transportation system safety and energy efficiency.
  - Examples:
    - Advanced driver-assistance systems (ADAS), such as adaptive cruise control, collision avoidance, automatic braking, and lane departure warning, may lead to a substantial reduction in vehicle crashes.
    - Higher levels of automation that enable the vehicle (rather than the human driver) to manage accelerating, braking, and steering control could eventually eliminate the cause of most traffic accidents
- Infrastructure-based solutions for connectivity to enable system-level controls for a transportation network, including automated intersection optimization, vehicle/traveler routing guidance, and technologies to optimize traffic flow, speed, and throughput;
- Algorithms, controls, and systems to improve the efficiency of individual vehicles in a traffic network, or multiple vehicles in communication with one another; and
- Devices and technologies to improve sensing, perception, and control and enable more efficient automated vehicle and transportation systems

AOI 4: Predictive Modeling Capabilities for the Co-Optimization of Fuels and Multi- mode (SI/CI) Engines

- Coordination with multi-lab co-optimization of fuels and engines led by ORNL
- https://www.energy.gov/eere/vehicles/fuel-effects-advanced-combustion
- Predictively simulate the combustion of real fuels in complex engine geometries with a comprehensive computational fluid dynamics (CFD) towards Exascale computing
- Direct injection sprays;
- Chemical kinetics and emissions formation;
- Heat transfer;
- Turbulent flame development and propagation; and
- High-energy ignition

AOI 5: New Material and Engine Technologies for High-Efficiency Powertrains

- Coordinate with Advanced Powertrain Materials Core Program led by ORNL
- Next gen high-efficiency, very-low-emission internal combustion engine
  - New combustion strategies
  - Advanced materials
  - New materials processing

Minimum Performance Targets (Relative to 2015 baseline vehicle)

Vehicle Size Class	Weight Reduction	Vehicle Fuel Economy Improvement	Emissions Compliance	Test Cycle
Class 1-2 (Midsize Cars and Crossovers)	15%	23%	Tier 3/LEV III	FTP 75
Class 3-6 (Midsize Trucks)	15%	10%	CI Engines: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100O9ZZ.pdf SI Engines: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100OA01.pdf	Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-duty Engines and Vehicles Phase 2 (40, 49 CFR)

Applicant must be a vehicle manufacturer or tier 1 supplier with a productions of at least 20,000 units

AOI 6: Technology Integration

- Alternative Fuel Vehicles (AFVs) and Infrastructure for Resiliency and Emergency Preparedness
- New Mobility Services in Rural America
- Alternative Fuel (e.g. natural gas) Proof-of-Concept in New Communities and Fleets
- EV Data Collection
- Open Topic for Clean Cities coalitions to improve domestic energy security

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