

## Notice of Intent No. DE-FOA-0001680

### Notice of Intent to Issue Funding Opportunity Announcement No. DE-FOA-0001647

The Office of Energy Efficiency and Renewable Energy (EERE) intends to issue, on behalf of the Fuel Cell Technologies Office (FCTO), a Funding Opportunity Announcement (FOA) entitled “Fuel Cell Technologies Office Annual FOA”.

The FCTO is a key component of the Department of Energy’s (DOE) EERE portfolio. Fuel cells powered by hydrogen from renewable or low-carbon resources can lead to substantial energy savings and reductions in imported petroleum and carbon emissions. The FCTO aims to provide clean, safe, secure, affordable, and reliable energy from diverse domestic resources, providing the benefits of increased energy security and reduced criteria pollutants and green-house gas emissions through research, development and demonstration (RD&D) to address both key technical challenges for fuel cells and hydrogen fuels (i.e. hydrogen production, delivery and storage) and institutional barriers such as hydrogen codes and standards.

It is anticipated that the FOA will include 4 topics that are detailed below. The first 3 topics will leverage FCTO’s national lab consortia launched under the DOE Energy Materials Network (EMN) in FY16, in support of the President’s Materials Genome Initiative and advanced manufacturing priorities. Consortia that will be leveraged include: ElectroCat, HydroGEN, and HyMARC (additional information is below). Applicants will be encouraged to leverage consortia capabilities in their research, and share research results with consortia data portals. Interested applicants are encouraged to explore consortia capabilities, and interface with consortia steering committees prior to the release of the FOA. To help facilitate this, FCTO plans to hold webinars and/or weekly public teleconferences with technical representatives from each consortium in the coming weeks, wherein interested applicants can ask questions about the consortia’s capabilities. These webinars and teleconferences will be open to the public and their recordings will be publically posted to ensure everyone has the same access. To ensure you are notified of upcoming FCTO webinars, please subscribe to our Fuel Cell News and Financial Opportunity Updates at the following link: <http://energy.gov/eere/fuelcells/subscribe-news-and-financial-opportunity-updates>.

- 1. ElectroCat - Fuel Cell R&D: PGM-Free Catalysts and Electrodes (up to \$2M per award, 4-5 awards, 1-3 years, maximum federal funding of \$10M)**

Applications will be sought for novel and innovative concepts that advance the development of platinum group metal-free (PGM-free) oxygen reduction electrocatalysts and electrodes for use

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in polymer electrolyte membrane fuel cells (PEMFCs) with a primary focus on automotive applications. As part of the DOE EMN, the ElectroCat consortium aims to accelerate the rate of development of high-performing and durable PGM-free catalysts and electrodes to significantly reduce fuel cell cost. The goal of this topic is to develop durable PGM-free catalysts that achieve activity of 0.044 A/cm<sup>2</sup> at 0.9 V in a PEMFC membrane electrode assembly (MEA) by 2020, representing ≈ 80% improvement over the 2015 baseline and equivalent with the mass activity target for platinum-based catalysts. Proposed projects are expected to leverage specified collaboration with one or more ElectroCat national lab-based capabilities, which would include the employment of high-throughput, combinatorial techniques and advanced computational tools within the consortium to guide research and development. Projects for this topic will be up to 3 years in length with interim Go/No-Go decision points. Please visit the ElectroCat Consortium website<sup>1</sup> for additional information. Interested applicants are encouraged to interface with the ElectroCat Steering Committee to understand the consortium's capabilities, and determine potential for collaboration before the FOA is released. Once the FOA is released, communication with the Steering Committee will be restricted to public webinars and teleconferences.

## **2. HydroGEN - Advanced Water Splitting Materials for Hydrogen Production**

Subtopic 2a – Advanced Water Splitting Materials for Hydrogen Production (\$250K-\$1M per award, 6-8 awards, 1-3 years, maximum federal funding of \$6M) :

Applications will be sought for seedling projects to conduct materials development for renewable hydrogen production, leveraging capabilities in the HydroGEN consortium within the DOE EMN. Projects will focus on functional materials for advanced electrolysis, photoelectrochemical (PEC) water splitting, and solar thermochemical (STCH) water splitting. Projects will be required to demonstrate advancement toward FCTO's 2020 targets for durability, efficiency, and cost; relevant targets include an overall energy efficiency of over 75% for electrolysis, solar-to-hydrogen (STH) energy conversion ratio of at least 26% for STCH materials, and STH energy conversion ratio of at least 25% for PEC materials. Further information on specific material requirements can be found in the DOE Fuel Cell Technologies Office Hydrogen Production Multi-year Research, Development, and Demonstration plan.<sup>2</sup> The projects will initially be funded for a 12-18 month Phase I to demonstrate feasibility of the concept. Only concepts that are demonstrated to be feasible and meet agreed upon minimum performance criteria will be funded for additional Phases up to 3 years in total. A website for HydroGEN will be available later this year. Interested applicants are encouraged to interface with the HydroGEN Steering Committee to understand the consortium's capabilities, and determine potential for collaboration before the FOA is released. Once the FOA is released,

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<sup>1</sup> <http://www.electrocat.org>

<sup>2</sup> [http://energy.gov/sites/prod/files/2015/06/f23/fcto\\_myrrdd\\_production.pdf](http://energy.gov/sites/prod/files/2015/06/f23/fcto_myrrdd_production.pdf)

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communication with the Steering Committee will be restricted to public webinars and teleconferences.

Subtopic 2b - Materials Benchmarking Platforms for Advanced Water Splitting Technologies (\$1M-\$3M per award, 1-2 awards, 1-3 years, maximum federal funding of \$4M):

Applications will be sought for the development of protocols to benchmark key performance metrics of renewable water splitting pathways, including advanced electrolytic, PEC, and STCH water splitting. While FCTO has funded the development of benchmarking platforms for each pathway in the past, improved alignment of metrics across the pathways would enable more accurate comparisons and elucidate new materials development needs. The lack of standard approaches to characterizing system efficiency, production rate, cost, life cycle greenhouse gas emissions, and other relevant metrics was identified as a gap in FCTO's 2016 Advanced Water Splitting Materials Workshop.<sup>3</sup> Deliverables from Subtopic 2b projects will include the development of standard protocols that can ultimately be used to characterize the performance and materials needs of each pathway. FCTO anticipates that applications for this topic will be up to 3 year projects and they will also leverage capabilities in the HydroGEN consortium within the DOE EMN. Interested applicants are encouraged to interface with the HydroGEN Steering Committee to understand the consortium's capabilities, and determine potential for collaboration before the FOA is released. Once the FOA is released, communication with the Steering Committee will be restricted to public webinars and teleconferences.

**3. HyMARC- Hydrogen Storage Materials for Automotive Applications (\$250K-\$1M per award, 5-10 awards, 1-3 years, maximum federal funding of \$9M)**

Applications will be sought for seedling projects to develop innovative and novel rechargeable hydrogen storage material concepts for use in automotive applications enabling higher capacity and lower cost hydrogen storage systems. These projects, working collaboratively with the HyMARC (Hydrogen Materials – Advanced Research Consortium)<sup>4</sup> within the DOE EMN, will focus on materials with reversible capacities and sufficient charge/discharge kinetics within the operating temperature and pressure window to meet fuel cell requirements onboard vehicles. Further information on specific material requirements can be found on the DOE Fuel Cell Technologies Office Hydrogen Storage website.<sup>5</sup> The projects for this topic will initially be funded for a 12-18 month Phase I to demonstrate feasibility of the concept. Only concepts that are demonstrated to be feasible and meet agreed upon minimum performance criteria will be funded for additional Phases up to 3 years in total.

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<sup>3</sup> <http://energy.gov/eere/fuelcells/downloads/advanced-water-splitting-materials-workshop>

<sup>4</sup> <http://energy.gov/eere/fuelcells/hymarc-hydrogen-materials-advanced-research-consortium>

<sup>5</sup> <http://energy.gov/eere/fuelcells/materials-based-hydrogen-storage>

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**4. Precursor development for low-cost, high-strength carbon fiber for use in composite overwrapped pressure vessel applications (up to \$1M per award, 3-4 awards, 3 years, maximum federal funding of \$4M).**

Applications will be sought for research and development of lower-cost precursor materials for high-strength carbon fiber for use in Composite Overwrapped Pressure Vessels (COPVs) for onboard hydrogen storage. Carbon fiber (CF) reinforced composites are used to make COPVs rated for 700 bar service for fuel cell electric vehicles. The predominate CF used is Toray T-700S with a rated tensile strength of 711 ksi and modulus of 33 Msi, and an estimated cost of \$28.67/kg. In order to reduce the cost of COPVs to meet the DOE 2020 cost targets, the cost of CF used in 700 bar COPVs must be significantly reduced. The cost of CF is about equally divided between the cost of precursor fibers and the conversion of the precursor fiber to CF.

Essentially all high strength CF is produced from precursor fibers containing at least 92% polyacrylonitrile (PAN), typically in tows of 12,000 to 24,000 strands. Prior work at ORNL, with support from the Vehicle Technologies Office (VTO) and FCTO, led to the development of precursor fiber of PAN comonomered with methyl acrylate (PAN-MA). This precursor fiber, produced on a high-volume textile fiber manufacturing line, produced CF with properties similar to Toray T-700S, at a potential cost of \$23.43/kg, which is approximately an 18% cost reduction compared to the Toray T-700S.<sup>6</sup> Applications will be requested for novel formulations of PAN with comonomers and additives that can reduce the cost of the precursor fiber and reduce the cost of conversion to CF with properties similar to Toray T-700S. Also requested will be proposals for low-cost polyolefin precursor materials that can be polymerized and drawn into fibers for conversion to CF with properties similar to Toray T-700S. Other precursors may be considered only if sufficient evidence is provided that shows they have potential to meet the DOE targets. Cost savings may be realized through lower cost material, higher mass yield on conversion to CF, lower processing temperatures for conversion and higher conversion rates. It is anticipated that these projects would run up to 3 years in length with interim Go/No-Go decision points. Applicants are encouraged to leverage carbon fiber characterization and scale up resources within the DOE National Laboratory system as appropriate; a host of carbon fiber capabilities are now available through the LightMat consortium (<http://LightMat.org>) within the Energy Materials Network.

Note: This work is differentiated from the CF precursor work sought by the VTO. VTO is seeking to develop a computational approach, with high-throughput screening and model validation, to develop precursors for CF with tensile strengths of 250 ksi and modulus of 25 Msi, significantly lower than required for COPVs. It is expected that once the computational model is developed and validated through the multi-phase, 4 year VTO project, a follow-on project could be run to extend the computational model and screening to high-strength CF precursors.

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<sup>6</sup> [https://www.hydrogen.energy.gov/pdfs/15013\\_onboard\\_storage\\_performance\\_cost.pdf](https://www.hydrogen.energy.gov/pdfs/15013_onboard_storage_performance_cost.pdf)

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Additional Information:

EERE envisions awarding multiple financial assistance awards in the form of cooperative agreements. The estimated period of performance for each award will vary by topic area and is provided above.

This Notice is issued so that interested parties are aware of the EERE's intention to issue this FOA in the near term. All of the information contained in this Notice is subject to change. EERE will not respond to questions concerning this Notice. Once the FOA has been released, EERE will provide an avenue for potential Applicants to submit questions.

EERE plans to issue the FOA in the fall of 2016 via the EERE Exchange website <https://eere-exchange.energy.gov/>. If Applicants wish to receive official notifications and information from EERE regarding this FOA, they should register in EERE Exchange. When the FOA is released, applications will be accepted only through EERE Exchange.

In anticipation of the FOA being released, Applicants are advised to complete the following steps, which are **required** for application submission:

- Register and create an account in EERE Exchange at <https://eere-exchange.energy.gov/>. This account will allow the user to register for any open EERE FOAs that are currently in EERE Exchange. It is recommended that each organization or business unit, whether acting as a team or a single entity, use only one account as the contact point for each submission. Questions related to the registration process and use of the EERE Exchange website should be submitted to: [EERE-ExchangeSupport@hq.doe.gov](mailto:EERE-ExchangeSupport@hq.doe.gov)
- Obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number (including the plus 4 extension, if applicable) at <http://fedgov.dnb.com/webform>
- Register with the System for Award Management (SAM) at <https://www.sam.gov>. Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in SAM registration. Please update your SAM registration annually.
- Register in FedConnect at <https://www.fedconnect.net/>. To create an organization account, your organization's SAM MPIN is required. For more information about the SAM MPIN or other registration requirements, review the FedConnect Ready, Set, Go! Guide at [https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect\\_Ready\\_Set\\_Go.pdf](https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf)
- Register in Grants.gov to receive automatic updates when Amendments to a FOA are posted. However, please note that applications will not be accepted through

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Grants.gov. <http://www.grants.gov/>. All applications must be submitted through EERE Exchange.

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