



U.S. Department of Energy
Advanced Research Projects Agency – Energy
Announcement of Teaming Partner List
for Upcoming Funding Opportunity Announcement:
Geologic Hydrogen

The Advanced Research Projects Agency Energy (ARPA-E) intends to issue a Funding Opportunity Announcement (FOA) focused on developing technology for the exploitation of Geologic Hydrogen as a sustainable source of hydrogen. The goal of this program is production at the lowest cost and emissions through the stimulation and extraction of hydrogen from subsurface mineral deposits.

As described in more detail below, the purpose of this announcement is to facilitate the formation of new project teams to respond to the upcoming Geologic Hydrogen program. The FOA will provide specific program goals, technical metrics, and selection criteria; and the FOA terms are controlling. For purposes of the Teaming Partner List, the following summarizes current planning for the program.

ARPA-E has identified two major technical categories and two supporting categories. Technical Category 1 is related to the investigation of stimulation methods to rapidly enhance the natural rate of hydrogen production from mineral sources. Technical Category 2 deals with the technologies in subsurface engineering, including the ways to contain, concentrate, and economically transport hydrogen to the well-head. Among these categories, ARPA-E has identified several modeling, characterization, and risk management needs that need to be associated with the technology development in Categories 1 and 2. Supporting these needs are categories focused on developing new ways to model and characterize the subsurface for the purposes of geologic hydrogen production (Category 3), and technologies to understand, predict and mitigate risks associated with the exploitation of geologic hydrogen as a resource (Category 4).

ARPA-E held a workshop on this topic in April 2023; information on this workshop can be found at <https://arpa-e.energy.gov/events/geologic-h2-workshop>. An Industry Day was held by ARPA-E Program Director Douglas Wicks on June 29, 2023.

The following is a non-exhaustive list of the technologies that will be of interest for the Geologic Hydrogen program. Within this list includes possible risk management, modeling, and characterization needs which should be addressed.

- *Stimulation and generation:* Technologies which enhance the natural rate of serpentinization or other equivalent hydrogen producing geochemical reactions (e.g., reduction of iron bearing minerals in banded iron formations, etc.).
- *Subsurface engineering:* Technologies which are related to engineering or creating subsurface hydrogen reservoirs, or technologies which can achieve a higher concentration/pressure of hydrogen prior to the well-head.
- *Down-hole gas separation:* Down-hole/upstream of well-head systems capable of separating subsurface gases to enable transport of higher purity hydrogen (in the case of production of coevolved or liberated gases). An example includes low cost, high flux, high selectivity membrane systems.



- *Risk mitigation methods:* Technologies that can predict, model, or prevent harmful side effects associated with enhanced stimulation of hydrogen generating mineralogical processes (e.g., serpentinization of ultramafic rocks). Focus should be given to understanding and addressing volumetric expansion, seismicity, hydrogen leakage and associated impact on greenhouse gas (GHG) emissions, biological effects, and subsurface contamination.
- *Modeling approaches:* Methods to predict the viability of subsurface resources for stimulated hydrogen generation, inform reservoir management, or assist with stimulation efforts.
- *Characterization:* Methods to map subsurface and ocean floor resources (ultramafic formations or other candidate formations) and quantify physiochemical properties of interest, specifically total Fe content, Fe(II) concentration, Fe(II)/Fe(III) ratio, specific surface area, permeability, or other parameters relevant to stimulated hydrogen generation.

The scope of the Geologic Hydrogen program is to uncover how underutilized mineral resources in the subsurface can be used as a new source of hydrogen with the lowest cost and emissions. Several other methods of subsurface hydrogen production or extraction are not in the scope of this program, such as:

- Gasification of existing hydrocarbon storages in the subsurface (e.g., coal, oil reserves).
- Subsurface conversion of methane into hydrogen.
- Technologies focused solely on extraction of naturally occurring/accumulating hydrogen.
- Methods of producing hydrogen that require carbon sequestration to meet program wide metric of GHG.
- Proposals focused on generating subsurface hydrogen through electrolysis of water.
- Technologies that are fully mature in other sectors (e.g., geothermal or oil & gas) and do not require substantial innovation to support subsurface hydrogen production.

The Geologic Hydrogen program goals are the development of technologies that can lead to hydrogen at the well-head of \$1/kg H₂ with emissions <1 kg CO₂e/kg H₂ and deposit potential >1 million m³ of H₂ (per deposit). To achieve the program goals, performance metrics include enhancing the natural hydrogen producing reactions and producing downhole hydrogen that is sufficiently pure and concentrated. Technologies will also have to perform sufficient modeling, characterization, and risk management approaches that result from their stimulation or extraction methods.

ARPA-E project teams will be required to construct and execute a commercialization strategy that is unique to their technology.

Due to the complex cross-disciplinary nature of the intended program, ARPA-E strongly encourages outstanding scientists and engineers from different organizations, scientific disciplines, and technology sectors with expertise in catalysis, subsurface engineering, geophysics, and other related fields. Interdisciplinary and cross-sector collaboration spanning organizational boundaries enables and accelerates the achievement of scientific and technological outcomes that were previously viewed as extremely difficult, if not impossible.

The Teaming Partner List is being compiled to facilitate the formation of new project teams. This list will be available on ARPA-E eXCHANGE (<http://arpa-e-foa.energy.gov>), ARPA-E's online application portal,



starting July 2023. The Teaming Partner List will be updated periodically, until the close of the Full Application period, to reflect new Teaming Partners who have provided their information.

Any organization that would like to be included on this list should complete all required fields in the following link: <https://arpa-e-foa.energy.gov/Applicantprofile.aspx>. Required information includes: Organization Name, Contact Name, Contact Address, Contact Email, Contact Phone, Organization Type, Area of Technical Expertise, and Brief Description of Capabilities.

By submitting a response to this Notice, respondents consent to the publication of the above-referenced information. **By facilitating and publishing this Teaming Partner List, ARPA-E is not endorsing, sponsoring, or otherwise evaluating the qualifications of the individuals and organizations that are self-identifying themselves for placement on this Teaming Partner List. ARPA-E reserves the right to remove any inappropriate responses to this Announcement (including lack of sufficient relevance to, or experience with, the technical topic of the Announcement).** ARPA-E will not pay for the provision of any information, nor will it compensate any respondents for the development of such information. Responses submitted to other email addresses or by other means will not be considered.

This Notice does not constitute a Funding Opportunity Announcement (FOA). No FOA exists at this time. Applicants must refer to the final FOA, expected to be issued in August 2023, for instructions on submitting an application, the desired technical metrics, and for the terms and conditions of funding.