

**FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT**



**U.S. Department of Energy
Golden Field Office**

Research and Development for On-Board Vehicular Hydrogen Storage

Funding Opportunity Number: DE-PS36-08GO98004P

Announcement Type: Initial

CFDA Number: 81.087

Issue Date:	01/10/2008
Preliminary Applications Due:	02/28/2008, 11:59 PM EST
Invitations for Final Applications Sent:	04/18/2008
Final Applications Due:	05/22/2008, 11:59 PM EDT

NOTE: REQUIREMENTS FOR GRANTS.GOV

Where to Submit

Applications must be submitted through Grants.gov to be considered for award. You cannot submit an application through Grants.gov unless you are registered. Please read the registration requirements carefully and start the process immediately. Remember you have to update your CCR registration annually. If you have any questions about your registration, you should contact the Grants.gov Helpdesk at 1-800-518-4726 to verify that you are still registered in Grants.gov.

Registration Requirements

There are several one-time actions you must complete in order to submit an application through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contract Registry (CCR), register with the credential provider, and register with Grants.gov). See <http://www.grants.gov/GetStarted>. Use the Grants.gov Organization Registration Checklist at <http://www.grants.gov/section3/OrganizationRegCheck.pdf> to guide you through the process. Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in the CCR registration process. Applicants who are not registered with CCR and Grants.gov should allow at least 21 days to complete these requirements.

IMPORTANT NOTICE TO POTENTIAL APPLICANTS: When you have completed the process, you should call the Grants.gov Helpdesk at 1-800-518-4726 to verify that you have completed the final step (i.e. Grants.gov registration).

Questions

Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov. Part VII of this announcement explains how to submit other questions to the Department of Energy (DOE).

Application Receipt Notices

After an application is submitted, the Authorized Organization Representative (AOR) will receive a series of five e-mails. It is extremely important that the AOR watch for and save each of the emails. It may take up to 2 business days from application submission to receipt of email Number 2. You will know that your application has reached DOE when the AOR receives email Number 5. You will need the Submission Receipt Number (email Number 1) to track a submission. The titles of the five e-mails are:

Number 1 – Grants.gov Submission Receipt Number

Number 2 – Grants.gov Submission Validation Receipt for Application Number

Number 3 – Grants.gov Grantor Agency Retrieval Receipt for Application Number

Number 4 – Grants.gov Agency Tracking Number Assignment for Application Number

Number 5 – DOE e-Center Grant Application Received

The last email will contain instructions for the AOR to register with the DOE e-Center. If the AOR is already registered with the DOE e-Center, the title of the last email changes to: Number 5 – DOE e-Center Grant Application Received and Matched. This email will

contain the direct link to the application in IIPS. The AOR will need to enter their DOE e-Center user id and password to access the application.

VERY IMPORTANT – Download PureEdge Viewer

In order to download the application package, you will need to install PureEdge Viewer. This small, free program will allow you to access, complete, and submit applications electronically and securely. For a free version of the software, visit the following web site: <http://www.grants.gov/DownloadViewer>.

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PART I – FUNDING OPPORTUNITY DESCRIPTION

A. INTRODUCTION

The Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) is requesting applications to support the President's Hydrogen Fuel and Advanced Energy Initiatives in developing a pathway to the widespread commercialization of hydrogen and fuel cell technologies. To support these initiatives, this DOE Hydrogen Funding Opportunity Announcement (FOA or "announcement") seeks to fund the research and development of viable hydrogen storage technologies for on-board vehicular applications. DOE intends to provide financial support for this effort under authority of the Energy Policy Act of 2005, Public Law 109-58, in particular the Spark M. Matsunaga Hydrogen Act of 2005, Title VIII – Hydrogen.

In his January 2003 State of the Union Address, President Bush announced the Hydrogen Fuel Initiative – "so that America can lead the world in developing clean, hydrogen-powered automobiles." In 2006, the President announced the Advanced Energy Initiative to confront the Nation's addiction to oil. He promised to tackle the serious challenges of climate change by changing the way we power our homes, businesses, and automobiles. Hydrogen is an alternative energy carrier that is an important part of our Nation's strategy for long-term energy security and environmental sustainability. Hydrogen storage technology – the ability to carry enough hydrogen on board a vehicle to enable a vehicle range of greater than 300 miles – is crucial to the success of the President's Initiatives. At the present time, no existing hydrogen storage technology meets the challenging performance requirements to make hydrogen-powered automobiles competitive with traditional vehicles. New and innovative ideas are needed, which is the motivation for this announcement. Projects funded through this announcement will be incorporated into the framework of The National Hydrogen Storage Project, which was initiated in 2005. More information about the National Hydrogen Storage Project can be found at http://www1.eere.energy.gov/hydrogenandfuelcells/storage/national_proj.html.

B. BACKGROUND

For transportation, the overarching technical challenge for hydrogen storage is how to store the amount of hydrogen required for a conventional driving range (greater than 300 miles), within the vehicular constraints of weight, volume, efficiency, safety, and cost. Durability over the performance lifetime of these systems must also be ensured and validated, and acceptable refueling times and hydrogen delivery flow rates must also be achieved.

The goal of DOE's hydrogen storage applied research activity is to develop viable vehicular hydrogen storage technologies to meet the following key objectives:

- By 2010, develop and verify on-board hydrogen storage systems achieving 2 kWh/kg (6 wt.%), 1.5 kWh/Liter, and \$4/kWh.
- By 2015, develop and verify on-board hydrogen storage systems achieving 3 kWh/kg (9 wt.%), 2.7 kWh/Liter, and \$2/kWh.

Assuming no major changes in the basic vehicle platform designs, the 2010 targets would enable some vehicles to achieve a driving range of at least 300 miles, while the 2015 targets would enable virtually all of the light duty vehicle platforms to achieve this driving range. In other words, these targets were developed with the vision that systems meeting the 2010 targets would enable some degree of market penetration for hydrogen-powered vehicles, while systems meeting the 2015 targets would enable mass market penetration.

See Table 1 in [Appendix B](#) for a complete list of the DOE's technical performance targets for on-board hydrogen storage systems. The technical targets for on-board hydrogen storage systems¹ were established through the FreedomCAR and Fuel Partnership between DOE, the U.S. Council of Automotive Research (USCAR), and five major energy companies². The key technical challenges are also described in [Appendix B](#).

DOE has conducted a series of workshops to identify R&D needs and to assess priorities and strategies for on-board hydrogen storage. Based on the findings from these workshops, the DOE issued a "Grand Challenge" to the scientific community for applied research in hydrogen storage in July 2003. This Grand Challenge called for the establishment of hydrogen storage Centers of Excellence for focused, applied R&D in metal hydrides, chemical hydrogen storage and sorbents, with multiple university, industry and federal laboratory partners. In addition, independent projects were solicited on new materials and concepts, off-board hydrogen storage systems, and analyses of life cycle cost, performance and environmental impact. Complementing the Grand Challenge, the DOE Office of Science issued solicitations in 2004 and 2006 for basic research to improve fundamental understanding of materials and processes for hydrogen production, storage and use. The Centers of Excellence and independent projects, together with existing DOE hydrogen storage efforts, constitute the framework for the National Hydrogen Storage Project.

The original Grand Challenge solicitation launched in 2003 was planned for approximately \$150 million over 5 years, subject to appropriations, and forms the basis for the bulk of DOE's current hydrogen storage activity. In 2006, the DOE issued a Funding Opportunity Announcement and a National Laboratory Program Announcement to continue to solicit new ideas in storage materials and concepts from the R&D communities. Six projects addressing new storage materials and storage safety issues were selected from these two announcements. Including awards in basic research from the DOE Office of Science, the DOE "National Hydrogen Storage Project" now includes roughly 40 universities, 15 companies and 10 federal laboratories.

A separate National Laboratory Call (DE-PS36-08GO98005), titled "Laboratory Call for Research and Development for On-Board Vehicular Hydrogen Storage," offers opportunities for National Laboratories to submit applications as primary applicants. These two announcements are parallel to each other and projects will be evaluated and selected using the same criteria. The total funding ceiling for all new awards selected from both announcements will be \$6,000,000, with no predetermined division of funding between the two announcements. **In total, these announcements are expected to result in approximately 3 to 6 new projects to complement the "Grand Challenge" activities.**

C. SCOPE OF ANNOUNCEMENT

DOE is requesting applications for the research and development of innovative technologies for on-board vehicular hydrogen storage systems. **The application process includes two phases -- a preliminary application phase and a final application phase. Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications.**

¹See the following websites for details on the targets:
http://www1.eere.energy.gov/hydrogenandfuelcells/storage/pdfs/targets_onboard_hydro_storage.pdf and
<http://www.eere.energy.gov/hydrogenandfuelcells/mypp/>

²The FreedomCAR and Fuel Partnership includes U.S. Department of Energy, USCAR (Chrysler LLC, Ford Motor Company and General Motors Corporation), BP America, Chevron Corporation, ConocoPhillips, ExxonMobil Corporation and Shell Hydrogen LLC.

The technical topic listed below, which is described in greater detail in [Appendix B](#), is the only eligible research area under this announcement.

Materials Discovery

Research and development areas sought include new materials and concepts in the following areas: advanced metal hydrides, chemical hydrogen storage materials, carbon-based materials, high surface area sorbents including bridged catalyst (spillover) materials and conducting polymers, and other novel approaches. However, neither hydrolysis of sodium borohydride nor pure, undoped single-walled carbon nanotubes as on-board storage media are being solicited to be consistent with the Program's no-go decisions in these areas³.

Applications in these areas will not be reviewed. For chemical hydrogen storage materials, off-board regeneration must be considered and concepts to meet DOE efficiency goals should be submitted⁴. Applications for new materials with improved hydrogen storage gravimetric and volumetric capacity, hydrogen uptake and discharge kinetics, energy efficiency, operating temperature and pressure, cycle life, cost and durability of materials upon exposure to contaminants are appropriate. Development and application of new processes (such as mechanochemistry, sonochemistry, irradiation, electro/magnetism etc.) that can aid in the development of unique material properties (nanostructures, low cost manufacturing, etc.) are also applicable. Finally, the scope includes approaches for high throughput/combinatorial synthesis, screening and testing of storage materials and other novel characterization techniques that can aid in and be applied to the efficient discovery of new materials.

Research and development of cylindrical high pressure or liquid on-board storage tanks and off-board storage are not sought under this announcement and will not be reviewed. However, novel concepts for conformable tanks and approaches for moderate pressure (≤ 150 bar) hybrid systems may be proposed.

Such projects will typically be high risk, "outside the box" concepts but with technical credibility to meet targets and potential for high pay-off.

It is intended that this Funding Opportunity Announcement will be issued on an annual basis, subject to congressional appropriations. New projects will be selected each fiscal year based on technical merit review, program policy review and the availability of funds. Project duration will typically be two to five years. The project duration will be subdivided into two or more phases with overall project go/no-go decision points between the phases.

The potential for an applicant to become a member of an existing Hydrogen Storage Center of Excellence will be considered by DOE after selections are made and will have no effect on the evaluation and selection process. However, applicants may indicate in their application their desire to join one of the existing Centers. In such cases, the relevant Center should be mentioned, along with a brief description of how the proposed project can benefit from or complement the ongoing Center work.

Applicants receiving an award under this announcement will be required to provide periodic reports and presentations to DOE. Refer to [Part VI.C](#) for further information.

³ See the following website for more information on the Program's no-go decisions:
http://www1.eere.energy.gov/hydrogenandfuelcells/hydrogen_publications.html#h2_storage.

⁴ For systems regenerated off-board, the regeneration efficiency goal is 60%, meaning that the content of the hydrogen delivered to the automotive power plant should be greater than 60% of the total energy input to the process, including the input energy of hydrogen and any other fuel streams for generating process heat and electrical energy.

PART II – AWARD INFORMATION

A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding both grants and cooperative agreements under this program announcement. If it is determined that a cooperative agreement is the appropriate award instrument, the nature of the Federal involvement will be included in a special award provision. (See [Part VI.B.4](#), Statement of Substantial Involvement)

B. ESTIMATED FUNDING

A separate National Laboratory Call (DE-PS36-08GO98005), titled “Laboratory Call for Research and Development for On-Board Vehicular Hydrogen Storage,” offers opportunities for National Laboratories to submit applications as primary applicants. These two announcements are parallel to each other and projects will be evaluated and selected using the same criteria. The total funding ceiling for all new awards selected from both announcements will be \$6,000,000, with no predetermined division of funding between the two announcements. **In total, these announcements are expected to result in approximately 3 to 6 new projects to complement the “Grand Challenge” activities.** See [Part III.C](#) for information regarding an FFRDC as a team member under primary applicants.

Approximately \$1,000,000 is expected to be available for new awards under these parallel announcements in FY 2008. Approximately \$3,000,000 to \$6,000,000 in total is expected to be available for new awards made under these announcements over the 2 to 5-year lifetime of the awards, subject to Congressional appropriations.

C. EXPECTED NUMBER OF AWARDS

DOE anticipates making 3-6 awards total under both announcements explained above, depending on the size of the awards.

D. ANTICIPATED AWARD SIZE

DOE expects to fund each award at \$400,000 to \$3,000,000 over 2 to 5 years. If requested levels are higher, applicants must justify the need for more funds. The awards will be incrementally funded, where the amounts available each fiscal year will vary depending on the funds available, number of awards, technical merit review, and program policy review.

E. PERIOD OF PERFORMANCE

Projects will range from 2 to 5 years in duration. The overall project duration, called a project period, will be subdivided into two or more phases, or “budget periods,” with overall go/no-go decision points between the phases.

PART III - ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS

All types of domestic applicants are eligible to apply, except other Federal agencies, Federally Funded Research and Development Centers (FFRDCs), and nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995.

Foreign participants are not eligible as the prime applicant. However, foreign participants are allowed as subrecipients to a domestic applicant provided that:

- The foreign subrecipient effort, in aggregate, shall not exceed 1/3 of the total estimated cost of the project, including the applicant's and the foreign subrecipient's portions of the effort.
- The foreign participant must provide at least 20% cost sharing of their portion of the total project cost.

B. COST SHARING

The cost share must be at least 20% of the total allowable costs (i.e., the sum of the Government share, including FFRDC subcontractor costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project) and must come from non-Federal sources unless otherwise allowed by law.

C. OTHER ELIGIBILITY REQUIREMENTS

Federally Funded Research and Development Center (FFRDC) Subcontractors

FFRDC applicants are not eligible for an award under this announcement, but they may be proposed as subcontractors (or subrecipients) on another entity's application, subject to the following guidelines:

Authorization for non-DOE/NNSA FFRDCs. The Federal agency sponsoring the FFRDC subcontractor must authorize in writing the use of the FFRDC subcontractor on the proposed project and this authorization must be submitted with the preliminary application. The use of an FFRDC subcontractor must be consistent with the FFRDC's authority under its contract. Save the authorization in a single file named "FFRDC_Auth.pdf," and click on "Add Optional Other Attachment" to attach (see [Part IV.B.2](#) for further submission instructions).

Authorization for DOE/NNSA FFRDCs. The cognizant contracting officer for the FFRDC must authorize in writing the use of a DOE/NNSA FFRDC subcontractor on the proposed project and this authorization must be submitted with the preliminary application. Save the authorization in a single file named "FFRDC_Auth.pdf," and click on "Add Optional Other Attachment" to attach (see [Part IV.B.2](#) for further submission instructions). The following wording is acceptable for this authorization.

"Authorization is granted for the _____ Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory and will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory."

Value/Funding. The value of, and funding for, the FFRDC subcontractor portion of the work will not normally be included in the award to a successful applicant. Usually, DOE/NNSA will fund a DOE/NNSA FFRDC subcontractor through the DOE field work proposal system and other FFRDC subcontractors through an interagency agreement with the sponsoring agency.

Cost Share. The applicant's cost share requirement will be based on the total cost of the project, including the applicant's and the FFRDC subcontractor's portions of the effort.

Responsibility. The applicant, if successful, will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues, including but not limited to, disputes and claims arising out of any agreement between the applicant and the FFRDC subcontractor.

PART IV – APPLICATION AND SUBMISSION INFORMATION

A. ADDRESS TO REQUEST APPLICATION PACKAGE

Application forms and instructions are available at Grants.gov. To access these materials, go to <http://www.grants.gov>, select “Apply for Grants,” and then select “Download a Grant Application Package.” Enter the CFDA and/or the funding opportunity number located on the cover of this announcement and then follow the prompts to download the application package. NOTE: You will not be able to download the application package unless you have installed PureEdge Viewer (See: <http://www.grants.gov/DownloadViewer>).

B. CONTENT AND FORM OF PRELIMINARY APPLICATION – SF 424

Preliminary applications are required. You must complete the SF 424 and Other Attachments Forms, attach your preliminary application file in the block provided, and submit electronically through Grants.gov at www.Grants.gov.

The application process will include two phases – a preliminary application phase and a final application phase. Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications.

You must complete the mandatory forms and any applicable optional forms in accordance with the instructions on the forms and the additional instructions below. **Files that are attached to the forms must be in Adobe Portable Document Format (PDF) unless otherwise specified in this announcement.**

1. SF 424 - Application for Federal Assistance (PureEdge Form)

Complete all required fields in accordance with the pop-up instructions on the form. **It is highly recommended that you read the instructions carefully. To activate the instructions, turn on the “Help Mode” (Icon with the pointer and question mark at the top of the form).** The list of certifications and assurances referenced in Field 21 can be found at http://management.energy.gov/business_doe/business_forms.htm, under Certifications and Assurances.

Note: The dates and dollar amounts on this form should pertain to the entire project period, not just the first year, first phase, or other subset of the project period.

2. Other Attachments Form (PureEdge Form)

Submit the following files with your application by attaching them to the Other Attachments Form. Click on “Add Mandatory Other Attachment” to attach the Project Narrative. Click on “Add Optional Other Attachment,” to attach the personnel resumes and the FFRDC Authorization, if applicable.

Project Narrative File - Mandatory Other Attachment

The Project Narrative should provide a clear description of the work to be undertaken and how you plan to accomplish it. It should address each of the preliminary merit review criteria and sub-criteria listed in [Part V.A.2](#). Provide sufficient information so that the reviewers will be able to evaluate the application in accordance with these merit review criteria. Do not include any Internet addresses (URLs) that provide information necessary to review the application. See [Part VIII.D](#) for instructions on how to mark proprietary information in the application.

The Project Narrative file must be formatted to separately address each of the sections listed below. Each section must not exceed the specified page limitation when printed using standard 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right). The font must not be smaller than 11 point.

The Project Narrative must not exceed 7 pages total as prescribed below. If you wish to include graphics and visual material, including charts, graphs, maps, photographs, and other pictorial presentations, this information must be included in the Narrative document and will be counted in the page limitation for each section. Any pages that exceed the specified maximum number of pages for any section will be removed and will not be considered during the evaluation. Evaluators will review only the number of pages specified.

Save all of the Project Narrative information in a single PDF file, named "Project.pdf," and click on "Add Mandatory Other Attachment" to attach.

The Narrative should consist of the following sections, with page limits where indicated:

a) Cover Page (one-page limit)

The Narrative cover page should indicate the name and type of organization, the announcement number, the project title, and both the technical and business points of contact for the applicant, denoting the names, titles, addresses, telephone and facsimile numbers, and electronic mail addresses. The cover page should also identify the name and type of organization for all other participants, along with names, titles, addresses, telephone and facsimile numbers, and electronic mail addresses of participant contacts.

b) Technical Summary (one-page limit)

A one-page technical summary should be included in the Narrative to describe the proposed project in technical terms and explain how the proposed project will work toward the achievement of the targets and objectives in [Appendix B](#). The name of the applicant and title of the proposed project shall be indicated at the top of the summary page. The summary may contain information that is not releasable to the public. It is intended for use by technical evaluators.

c) Technical Proposal (5-page limit)

The technical proposal portion of the Narrative should be structured in accordance with the following sections (the structure, order of contents, etc. within a section are at the discretion of the applicant). If you wish to include graphics and visual material, including charts, graphs, maps, photographs, and other pictorial presentations, this information must be included in the Technical Proposal section and will be counted in the page limitation for this section. Lists of references for the document will not count against the page limit.

Section I: Technical Concept and Impact

- Describe the objectives of the proposed technical concept, the specific technical challenges being addressed, and the overall relevance and applicability of the concept and approach to the specific objectives of the DOE Hydrogen Storage Subprogram
- Address the feasibility of the concept, including a qualitative discussion of prior or ongoing proof-of-concept work
- Describe the innovation of the proposed technology or methodology compared to previous and ongoing work by others

- Address and quantify the degree to which the project will advance hydrogen storage technology for on-board vehicular applications toward the program’s specific technical performance targets

Section II: Work Plan

- Describe the work plan, including task descriptions, a schedule with milestones and go/no-go decision points, and the go/no-go decision criteria for the proposed project
- Address the experience of the Principal Investigator and the project team in performing research in this discipline or related areas; provide a brief description of the relevant facility capabilities

Applicants should review [Part V.A.2](#), Evaluation Criteria for Preliminary Applications, to be certain that all aspects of the evaluation criteria are adequately covered in the Technical Proposal.

Personnel Resumes – Optional Other Attachment

The application should include resumes for key personnel of the applicant and major participants. This file must be submitted in PDF format. This file should be included as an attachment file rather than with the narrative file (these resumes will not count against the page limit). Provide this information in a single file named “Resumes.pdf” and click on “Add Optional Other Attachment” to attach.

FFRDC Authorization (if applicable) - Optional Other Attachment

If an FFRDC is proposed as a subcontractor (or subrecipient), a special authorization is required as described in [Part III.C](#). Save the authorization in a single file named “FFRDC_Auth.pdf” and click on “Add Optional Other Attachment” to attach.

Summary of Required Forms and Files for Preliminary Applications

Your preliminary application must include the following documents:

Name of Document	Format	File Name
SF 424 - Application for Federal Assistance	PureEdge Form	N/A
Other Attachments Form (Attach the following files to this form):	PureEdge Form	N/A
Project Narrative File	PDF	Project.pdf
Personnel Resumes	PDF	Resumes.pdf
FFRDC Authorization (if applicable)	PDF	FFRDC_Auth.pdf

C. CONTENT AND FORM OF FINAL APPLICATION – SF 424 (R&R)

Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications.

You must complete the mandatory forms and any applicable optional forms in accordance with the instructions on the forms and the additional instructions below. **Files that are attached to the forms must be in Adobe Portable Document Format (PDF) unless otherwise specified in this announcement.**

1. SF 424 (R&R) (PureEdge Form)

Complete this form first to populate data in other forms. Complete all the required fields in accordance with the pop-up instructions on the form. **It is highly recommended that you read the instructions carefully. To activate the instructions, turn on the “Help Mode” (Icon with the pointer and question mark at the top of the form).** In particular, please note that **line 16a is intended to be the requested Federal funds only, although the title for that line might indicate otherwise.** The list of certifications and assurances referenced in Field 18 can be found on the Applicant and Recipient Page at http://management.energy.gov/business_doe/business_forms.htm, under Certifications and Assurances.

2. RESEARCH AND RELATED Other Project Information (PureEdge Form)

Complete questions 1 through 5 and attach files. The files must comply with the following instructions:

Project Summary/Abstract (Field 6 on the Form)

The Project Summary/Abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and major participants (for collaborative projects). **This document must not include any proprietary or sensitive business information as DOE may make it available to the public.** The Project Summary/Abstract must not exceed 1 page when printed using standard 8.5” by 11” paper with 1” margins (top, bottom, left and right) with font not smaller than 11 point. Save this information in a file named “Abstract.pdf,” and click on “Add Attachment” to attach.

Project Narrative (Field 7 on the R&R Other Project Information form)

The Project Narrative should provide a clear description of the work to be undertaken and how you plan to accomplish it. It should address each of the final merit review criteria and sub-criteria listed in [Part V.A.2](#). Provide sufficient information so that the reviewers will be able to evaluate the final application in accordance with these merit review criteria. Do not include any Internet addresses (URLs) that provide information necessary to review the application. See [Part VIII.D](#) for instructions on how to mark proprietary information in the application.

The Project Narrative file must be formatted to separately address each of the sections listed below. Each section must not exceed the specified page limitation, if any, when printed using standard 8.5” by 11” paper with 1 inch margins (top, bottom, left, and right). The font must not be smaller than 11 point.

The Project Narrative must not exceed the page limits where indicated in the descriptions below. If you wish to include graphics and visual material, including charts, graphs, maps, photographs, and other pictorial presentations, this information must be included in the Narrative document and will be counted in the page limitation for each section. Any pages that exceed the specified maximum number of pages below for any section will be removed and will not be considered during the evaluation. Evaluators will review only the number of pages specified.

Save all of the Project Narrative information in a single PDF file, named "Project.pdf" and click on "Add Attachment" to attach.

The Narrative should consist of the following sections, with page limits where indicated in the descriptions below.

a) Cover Page (one-page limit)

The Narrative cover page should indicate the name and type of organization, the announcement number, the project title, and both the technical and business points of contact for the applicant, denoting the names, titles, addresses, telephone and facsimile numbers, and electronic mail addresses. The cover page should also identify the name and type of organization for all other participants, along with names, titles, addresses, telephone and facsimile, and electronic mail addresses of participant contacts.

b) Table of Contents (no page limit)

The Narrative should include a Table of Contents and page numbers corresponding to the elements outlined herein. The Table of Contents does not have a page limit.

c) Technical Proposal (10-page limit)

The technical proposal portion of the Narrative should be structured in accordance with the following sections (the structure, order of contents, etc. within a section are at the discretion of the applicant). If you wish to include graphics and visual material, including charts, graphs, maps, photographs, and other pictorial presentations, this information must be included in the Technical Proposal section and will be counted in the page limitation for this section. Lists of references for the document will not count against the page limit.

Section I: Technical Concept

- Describe the objectives of the proposed concept, the specific technical challenge(s) being addressed, and the relevance of the technical concept to the technical objectives of the announcement
- Describe the proposed technical concept in detail; include experimental data and prior results to demonstrate the viability of the concept
- Describe the innovation of the proposed concept and how the concept offers advantages over current emerging technologies and methodologies
- Identify the key technical risk areas of the proposed concept and describe the appropriate mitigation strategies to address them
- Describe and quantify the potential of the proposed concept to advance the technology and to achieve DOE's specific technical performance targets for on-board storage systems; provide projections for the performance and energy requirements of the material or concept as appropriate (e.g. gravimetric and volumetric capacities on a material basis, temperatures, pressures, refilling and

discharge rates, energy required for hydrogen release, etc.)

Section II: Work Plan

Statement of Project Objectives

- Define the goals and objectives of the project
- Describe how the proposed work plan will successfully meet the project goals
- Describe the work breakdown structure, including detailed task descriptions and a project schedule
- Define and describe the major milestones in the schedule
- Describe the technical and administrative deliverables that will be produced throughout the project, including the specific end result or end product of each phase
- Define and describe overall project go/no-go decision points, including the quantitative criteria for how these go/no-go decisions will be made (e.g. achieving x g/L or y wt% hydrogen storage material capacity, where x , y , etc. are defined by the applicant as reasonable, yet progressive interim milestones toward meeting overall DOE targets)

Project Management

- Describe how the proposed project organization will facilitate project success
- Define the roles of the team members
- Describe the approach to managing the team and ensuring communication among team members
- Describe how project safety will be addressed, particularly handling of hydrogen and handling of potentially hazardous materials

Section III: Qualifications and Facilities

Personnel and Organization Qualifications

- Describe the education, professional training, technical skills, and work experience of the Principal Investigator (PI) and other key personnel, including personnel from major subcontractors
- Describe the level of time commitment of the PI and other key personnel, including personnel from major subcontractors, assigned to the proposed project
- Address the capability of the proposed team to address all aspects of the proposed work
- Describe the relevant experience of each organization on the proposed team in performing similar projects

Facilities

- Describe the applicant's existing facilities, and those of subcontractors, proposed for completing the work
- Describe and substantiate any request for new facilities or equipment

Applicants should also review [Part V.A.2](#), Evaluation Criteria for Final Applications, to be certain that all aspects of the evaluation criteria are adequately covered in the Technical Proposal.

d) Resources by Task (5-page limit)

The Narrative should include a summary of resources by Statement of Project Objectives task. The summary must include the following for the applicant and each participant:

- The job title and estimated number of hours for each of the key personnel proposed by task
- The estimated travel budget by task; the travel budget should include costs for up to two investigators for travel to Washington, DC twice per year for project reviews and one investigator to Detroit, MI once per year for DOE's meeting with the FreedomCAR and Fuel Partnership Hydrogen Storage Technical Team.
- The total proposed equipment, materials, and supplies budget by task

e) Bibliography/References Cited (no page limit)

Provide a bibliography of any references cited in the Project Narrative. Each reference should include the names of the authors, the article and journal title, book title, volume number, page numbers, and year of publication. Include only bibliographic citations. Applicants should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the application.

Bibliography & References Cited (Field 8 on the R&R Other Project Information form)

In order to reduce the number of files attached to your application, please provide the Bibliography/References Cited information as prescribed in the Project Narrative (see above). **Do not attach a file in field 8.**

Facilities & Other Resources (Field 9 on the R&R Other Project Information form)

In order to reduce the number of files attached to your application, please provide facilities and resource information as prescribed in the Project Narrative (see above). **Do not attach a file in field 9.**

Equipment (Field 10 on the R&R Other Project Information form)

In order to reduce the number of files attached to your application, please provide information on available and requested equipment as prescribed in the Project Narrative (see above). **Do not attach a file in field 10.**

Other Attachments (Field 11 on the R&R Other Project Information form)

If you need to elaborate on your responses to questions 1-5 on the "Research & Related Other Project Information" form, provide the information in a single file named "projinfo.pdf", which will not count against any page limits. Click on "Add Attachments" in Field 11 to attach file.

Also, attach the following files in Field 11, none of which will count against the page limits prescribed above for the Project Narrative:

- **Reference Checks on Federal Awards**

Provide the information below for at least five, and no more than eight, federal awards that were received by either your organization or principal investigator in the last five years for technologies relevant to this announcement, with award values in excess of \$500,000. If the applicant has fewer than five awards meeting this criteria, first submit those that meet the criteria, and for the remainder, provide information for federal awards over \$500,000 received by either the organization or principal investigator for all technologies in the last five years. Save this information in a single file named "RefChecks.pdf" and click on "Add Attachments" in Field 11 to attach.

The following information is required for each federal award: 1) AWARD TITLE; 2) INSTRUMENT NUMBER; 3) TOTAL AWARD VALUE (\$); 4) PERIOD OF PERFORMANCE (Dates); 5) APPLICANT'S PROJECT DIRECTOR (Name, Address, Telephone Number [including area code]); and 6) FEDERAL AGENCY MAKING AWARD (Agency Name, Federal Program Manager, Federal Program Manager's Address, Federal Program Manager's Telephone Number [including area code]).

- **Commitment Letters from Third Parties Contributing to Cost Sharing**

If a third party, (i.e., a party other than the organization submitting the application) proposes to provide all or part of the required cost sharing, the applicant must include a letter from the third party stating that it is committed to providing a specific minimum dollar amount of cost sharing. The letter should also identify the proposed cost sharing (e.g., cash, services, and/or property) to be contributed. Letters should be addressed to the DOE agency contact as identified in Part VII.B., and must be signed by the person authorized to commit the expenditure of funds by the entity. Provide this information in a single file named "CLTP.pdf" and click on "Add Attachments" in Field 11 to attach.

- **Personnel Resumes**

The application should include resumes for key personnel of the applicant and major participants. This file must be submitted in PDF format. Provide this information in a single file named "Resumes.pdf" and click on "Add Attachments" in Field 11 to attach.

- **Budget for DOE/NNSA Federally Funded Research and Development Center (FFRDC) Subcontractor, if applicable**

If a DOE FFRDC subcontractor is to perform a portion of the work, you must provide a DOE Field Work Proposal in accordance with the requirements in DOE Order 412.1 Work Authorization System. This order and the DOE Field Work Proposal form are available at http://management.energy.gov/business_doe/business_forms.htm. Save this information in a single file. Use up to 10 letters of the FFRDC name (plus .pdf) as the file name (e.g., lanl.pdf or anl.pdf) and click on "Add Attachments" in Field 11 to attach.

3. RESEARCH AND RELATED BUDGET (Total Fed + Non-Fed) (PureEdge Form)

Complete the Research and Related Budget (Total Fed + Non-Fed) form in accordance with the instructions on the form (Activate Help Mode to see instructions) and the following instructions. You must complete a separate budget for each budget period (project phase) of support requested. The form will generate a cumulative budget for the total project period. You must complete all the mandatory information on the form before the NEXT PERIOD button is activated. You may request funds under any of the categories listed as long as the item and

amount are necessary to perform the proposed work, meet all the criteria for allowability under the applicable Federal cost principles, and are not prohibited by the funding restrictions in this announcement (See [Part IV.G](#)).

Budget Justification (Field K on the R&R Budget form)

Provide supporting information for the following costs, including justification of need, basis or method of estimating costs, and relevant calculations (See R&R Budget instructions): personnel and fringe benefits; equipment; domestic and foreign travel; participant/trainees; material and supplies; publication; consultant services; computer services; subaward/consortium/contractual (specifically, provide the proposed budget amounts for each subcontractor individually); equipment or facility rental/user fees; alterations and renovations; and indirect costs. The budget justification must also identify the following information for each third party contributing cost sharing: (1) the name of the organization; (2) the proposed dollar amount to be provided; (3) the amount as a percentage of the total project cost; and (4) the proposed cost sharing – cash, services, or property. Provide any other information you wish to submit to justify your budget request. Attach a single budget justification file for the entire project period in Field K. The file automatically carries over to each budget year.

Summary of Required Forms and Files for Final Applications

Your application must include the following documents:

Name of Document	Format	Attach to
SF 424 (R&R)	PureEdge Form	N/A
RESEARCH AND RELATED Other Project Information	PureEdge Form	N/A
Project Summary/Abstract	PDF	Field 6
Project Narrative	PDF	Field 7
Reference Checks on Federal Awards	PDF	Field 11
Commitment Letters from Third Parties	PDF	Field 11
Personnel Resumes	PDF	Field 11
Budget for DOE/NNSA FFRDC subcontractor, if applicable (<i>Field Work Proposal</i>)	PDF	Field 11
RESEARCH AND RELATED BUDGET (Total Fed + Non-Fed)	PureEdge Form	N/A
Budget Justification	PDF	Field K

D. SUBMISSIONS FROM SUCCESSFUL FINAL APPLICANTS

If an applicant is selected for negotiation of an award, DOE reserves the right to request additional or clarifying information for any reason deemed necessary, including, but not limited to:

- Indirect cost information

- Other budget information
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5)
- Representation of Limited Rights Data and Restricted Software, if applicable

E. SUBMISSION DATES AND TIMES

1. Preliminary Application Due Date

Preliminary applications must be received by February 28, 2008, no later than 11:59 PM Eastern Time. You are encouraged to transmit your application well before the deadline.

Applications received after the deadline will not be reviewed or considered for award.

2. Invitations for Final Applications

Successful preliminary applications will receive invitations to submit a final application. These letters will be sent by April 18, 2008.

3. Final Application Due Date

Final applications must be received by May 22, 2008, no later than 11:59 PM Eastern Time. You are encouraged to transmit your application well before the deadline. **Applications**

received after the deadline will not be reviewed or considered for award.

F. INTERGOVERNMENTAL REVIEW

This program is not subject to Executive Order 12372 – Intergovernmental Review of Federal Programs.

G. FUNDING RESTRICTIONS

Cost Principles. Costs must be allowable in accordance with the applicable Federal cost principles referenced in 10 CFR part 600. The cost principles for commercial organizations are in FAR Part 31.

Pre-award Costs. Recipients may charge to an award resulting from this announcement pre-award costs that were incurred within the ninety (90) calendar day period immediately preceding the effective date of the award, if the costs are allowable in accordance with the applicable Federal cost principles referenced in 10 CFR part 600. Recipients must obtain the prior approval of the contracting officer for any pre-award costs that are for periods greater than this 90 day calendar period. Pre-award costs are incurred at the applicant's risk. DOE is under no obligation to reimburse such costs if for any reason the applicant does not receive an award or if the award is made for a lesser amount than the applicant expected.

H. OTHER SUBMISSION AND REGISTRATION REQUIREMENTS

1. Where to Submit

Applications must be submitted through Grants.gov to be considered for award. Submit electronic applications through the "Apply for Grants" function at www.Grants.gov. If you have problems completing the registration process or submitting your application, call Grants.gov at 1-800-518-4726 or send an email to support@grants.gov.

2. Registration Process

You must complete the one-time registration process ([all steps](#)) before you can submit your first application through Grants.gov (See www.grants.gov/GetStarted). **We recommend that you start this process at least three weeks before the application due date.** It may take 21 days or more to complete the entire process. Use the Grants.gov Organizational Registration Checklists at <http://www.grants.gov/section3/OrganizationRegCheck.pdf> to guide you through the process. **Important:** During the CCR registration process, you will be asked to designate an E-Business Point of Contact (EBIZ POC). The EBIZ POC must obtain a special password called “Marketing Partner Identification Number” (MPIN).

When you have completed the process, you should call the Grants.gov Helpdesk at 1-800-518-4726 to verify that you have completed the final step (i.e. Grants.gov registration).

More information on the registration process can be found in the REQUIREMENTS FOR GRANTS.GOV page at the beginning of this document.

PART V - APPLICATION REVIEW INFORMATION

A. CRITERIA

1. Initial Review Criteria

Prior to a comprehensive evaluation, an initial review of the applications will be performed by the DOE Golden Field Office (GO) to determine the following: 1) the applicant is eligible for an award; 2) the information required by the announcement has been submitted; 3) the minimum required cost share has been proposed; and 4) the proposed concept is responsive to the objectives of the announcement. If an application fails to meet these requirements, it may be deemed non-responsive and eliminated from further review. For applicants who do not pass the initial review, DOE will provide notice immediately upon completion of the initial review. This notice will consist of the findings of the initial review as determined by DOE/GO.

2. Merit Review Criteria

EVALUATION CRITERIA FOR PRELIMINARY APPLICATIONS

The following evaluation criteria will be used in the comprehensive evaluation of preliminary applications. For each criterion, the weighting (out of a total of 100%) is indicated to show the relative importance.

Criterion 1: Technical Concept and Impact (Weight: 75%)

- The overall relevance and applicability of the technical concept and approach in addressing the technical challenges facing on-board hydrogen storage and the specific objectives of the DOE Hydrogen Storage Subprogram
- The feasibility of the proposed technical concept, including evidence of prior and ongoing proof-of-concept work
- The quantitative degree to which the project will advance hydrogen storage technology for on-board vehicular applications toward the program's technical performance targets
- The innovation of the proposed technology or methodology compared to similar previous and ongoing work by others

Criterion 2: Work Plan (Weight: 25%)

- Appropriateness of the work plan, task structure, schedule, milestones, go/no-go decision points and go/no-go decision criteria for the proposed project
- Experience of the Principal Investigator and the project team in performing research in this discipline or related areas; the adequacy of the relevant facilities

For successful preliminary applicants, scores and rankings under the preliminary review will be discarded and will not be used for evaluation of the final applications.

EVALUATION CRITERIA FOR FINAL APPLICATIONS

The following evaluation criteria will be used in the comprehensive evaluation of final applications. For each criterion, the weighting (out of a total of 100%) is indicated to show the relative importance.

Criterion 1: Technical Concept (Weight: 60%)

- The relevance of the technical concept to the technical objectives of the announcement
- The technical viability of the proposed concept, including evidence of experimental data and prior results
- The innovation of the proposed technology and the extent to which the proposed concept offers advantages over current emerging technologies and methodologies
- The identification of the key technical risk areas of the proposed concept and mitigation strategies to address them
- The potential of the proposed concept to advance the technology and to achieve DOE's specific technical performance targets for on-board storage systems; the adequacy of projections provided by the applicant to indicate potential to meet DOE 2010 or longer term targets

Criterion 2: Work Plan (Weight: 25%)

Statement of Project Objectives

- The relevance and clarity of the goals and objectives of the project
- The likelihood of success of the proposed work plan to meet the project goals
- The clarity, adequacy and reasonableness of the work breakdown structure and task descriptions
- The adequacy, clarity and timing of major milestones
- The clarity and adequacy of technical and administrative project deliverables, including the specific end result or product of each phase of the project
- The adequacy, clarity and timing of go/no-go decision points as well as the quantitative criteria for how these go/no-go decisions will be made (e.g. achieving x g/L or y wt% hydrogen storage material capacity, where x, y, etc. are defined by the applicant as reasonable, yet progressive interim milestones toward meeting overall DOE targets)

Project Management

- The adequacy of the proposed project organization to facilitate project success
- The clarity and appropriateness of the roles of the team members
- The approach to managing the team and ensuring communication among team members
- Adequately addresses safety, particularly handling of hydrogen and handling of potentially hazardous materials

Criterion 3: Qualifications and Facilities (Weight: 15%)

Personnel and Organization Qualifications

- The adequacy of the education, professional training, technical skills, and work experience of the Principal Investigator (PI) and other key personnel, including personnel from major subcontractors

- The level and reasonableness of the time commitment of the PI and other key personnel, including personnel from major subcontractors, assigned to the proposed project
- The capability of the proposed team to address all aspects of the proposed work
- The relevant experience of each organization on the proposed team in performing similar projects

Facilities

- The adequacy of the applicant's existing facilities, and those of subcontractors, proposed for completing the work
- The reasonableness of any request for new facilities or equipment

For the final application, the proposed cost elements will not be point scored or adjectivally rated. However, they will be evaluated to determine if the total proposed amount is commensurate with the proposed effort.

3. Other Selection Factors

The selection official will consider the following program policy factors in the selection process:

- Selection of applications to achieve a balance of complementary projects, in conjunction with existing projects funded by the DOE Hydrogen Program, to meet the overall goals and objectives of that Program
- Selection of projects involving a diversity (types and sizes) of proposing organizations and technologies
- Selection of applications with comparatively significant cost/benefit advantages
- Selection of applications with applicant cost share above the minimum level required
- Geographic distribution of applicants within the U.S.
- Past performance of applicants on previous DOE-sponsored projects (lack of prior work with DOE will not result in a negative finding)

B. REVIEW AND SELECTION PROCESS

1. Merit Review

Applications that pass the initial review will be subject to a merit review in accordance with the guidance provided in the "Department of Energy Merit Review Guide for Financial Assistance and Unsolicited Proposals." This guide is at <http://management.energy.gov/documents/meritrev.pdf>.

After passing the initial review, preliminary applications will undergo a preliminary merit review process where applications are evaluated and scored according to the Evaluation Criteria for Preliminary Applications listed in [Part V.A.2](#) above. Selected preliminary applicants will then be notified by letter of the favorable results of the preliminary merit review and will be encouraged to submit a final application. Unsuccessful preliminary applicants will also be notified by letter of the results of the preliminary merit review and will be eliminated from further consideration. Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications. Final applications will then be evaluated, scored, and ranked

according to the Evaluation Criteria for Final Applications listed in [Part V.A.2](#) above by a final objective merit review committee. The final merit review committee will make recommendations to the Selection Official as to whether or not each final application is determined to have sufficient technical merit to be considered for funding based exclusively on the technical strengths and weaknesses of the application.

2. Selection

The Selection Official will consider the merit review recommendation, program policy factors, and the amount of funds available in making selection decisions.

3. Notice of Selection and Debriefings

After completing the comprehensive review of the preliminary applications, DOE will notify those applicants who are invited to submit final applications. This notification will include scores, strengths and weaknesses as determined by the Preliminary Merit Review Committee, which may be used to help strengthen final applications. DOE will also notify those applicants who do not move forward to the final application phase. This notification will include scores, strengths and weaknesses as determined by the Preliminary Merit Review Committee and will constitute the debriefing for the preliminary application phase.

After completing the comprehensive review of the final applications, DOE will notify applicants selected for award. This notice of selection is not an authorization to begin performance. (See [Part IV.G](#) with respect to the allowability of pre-award costs.) Organizations whose applications have not been selected will be advised as promptly as possible. This notice will include the consensus scores, strengths and weaknesses as determined by the Final Merit Review Committee and will constitute the debriefing for the final application phase.

4. Discussions and Award

The Government may enter into discussions with a selected applicant for any reason deemed necessary, including, but not limited to: (1) the budget is not appropriate or reasonable for the requirement; (2) only a portion of the application is selected for award; (3) the Government needs additional information to determine that the recipient is capable of complying with applicable requirements and regulations; and/or (4) special terms and conditions are required. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

DOE reserves the right to conduct an independent third party review of financial capability for applicants that are selected for negotiation of an award (including personal credit information of principal(s) of a small business if there is insufficient information to determine financial capability of the organization).

C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

DOE plans to send invitations to submit final applications to successful preliminary applicants by April 18, 2008. Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications.

DOE anticipates notifying applicants selected for negotiation of an award in August 2008 and making awards in September 2008.

PART VI - AWARD ADMINISTRATION INFORMATION

A. AWARD NOTICES

A Notice of Financial Assistance Award issued by the Contracting Officer is the authorizing award document. It normally includes, either as an attachment or by reference: 1. Special Terms and Conditions; 2. Applicable program regulations, if any; 3. Application as approved by DOE; 4. DOE assistance regulations at 10 CFR part 600, or, for Federal Demonstration Partnership (FDP) institutions, the FDP terms and conditions; 5. National Policy Assurances To Be Incorporated As Award Terms; 6. Budget Summary; and 7. Federal Assistance Reporting Checklist, which identifies the reporting requirements.

B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

1. Administrative Requirements

The administrative requirements for DOE grants and cooperative agreements are contained in 10 CFR part 600 (See: <http://ecfr.gpoaccess.gov>), except for grants made to Federal Demonstration Partnership (FDP) institutions. The FDP terms and conditions and DOE FDP agency specific terms and conditions are located on the National Science Foundation web site at http://www.nsf.gov/awards/managing/fed_dem_part.jsp.

2. Special Terms and Conditions and National Policy Requirements

The DOE Special Terms and Conditions for Use in Most Grants and Cooperative Agreements are located at http://management.energy.gov/business_doe/business_forms.htm under Award Terms. The National Policy Assurances To Be Incorporated As Award Terms are located at http://management.energy.gov/business_doe/business_forms.htm under Award Terms.

3. Intellectual Property Provisions

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at http://www.gc.doe.gov/financial_assistance_awards.htm.

4. Statement of Substantial Involvement

Either a grant or cooperative agreement may be awarded under this program announcement. If the award is a cooperative agreement, the DOE Specialist and DOE Project Officer will negotiate a Statement of Substantial Involvement with the selected applicant prior to award. For previous hydrogen storage funding opportunities, cooperative agreements have been awarded only for projects joining the existing Centers of Excellence in hydrogen storage. In those cases, the following Statement of Substantial Involvement was used:

“The DOE Project Officer and HQ Program Technology Development Manager, in their project management oversight role for the Hydrogen Storage Centers of Excellence (Centers), will coordinate the awardees’ efforts along with the efforts of the other Center participants, in order to assure the optimal overall performance of the Center toward meeting DOE’s programmatic goals. In this role, the DOE Project Officer and HQ Program Technology Development Manager shall encourage collaboration among the awardee and the various Center participants.”

It is anticipated that any cooperative agreements issued as a result of this announcement would include similar language.

C. REPORTING

Reporting requirements will be identified on the Federal Assistance Reporting Checklist, DOE F 4600.2, attached to the award. A sample of the Checklist can be found at https://www.eere-pmc.energy.gov/procurement/FinancialAssistance/Forms/DOE_Forms/DOEF4600_2.doc

Specific reporting requirements for all awards resulting from this announcement will include:

- Quarterly Technical Progress Reports
- Quarterly Financial Status Reports
- Annual presentations at the DOE Hydrogen Program Annual Merit Review and Peer Evaluation Meeting (typically in Washington, D.C.)
- Annual presentations at DOE/FreedomCAR and Fuel Partnership Hydrogen Storage Technical Team Meetings (typically in Detroit, MI)
- Annual submissions to the DOE Hydrogen Program's Annual Progress Report
- Project Safety Plan

PART VII - QUESTIONS/AGENCY CONTACTS

A. QUESTIONS

Questions regarding the content of the announcement must be submitted through the “Submit Question” feature of the DOE Industry Interactive Procurement System (IIPS) at <http://e-center.doe.gov>. Locate the program announcement on IIPS and then click on the “Submit Question” button. Enter required information. You will receive an electronic notification that your question has been answered. DOE will respond to a question within 5 business days, unless a similar question and answer have already been posted on the website.

Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov. DOE cannot answer these questions.

B. AGENCY CONTACT

Genevieve Wozniak
Grants and Agreements Specialist
U.S. Department of Energy
Golden Field Office
1617 Cole Boulevard
Golden, CO 80401

Email: h2storage@go.doe.gov
Telephone: 303-275-4942
Fax: 303-275-4754

PART VIII - OTHER INFORMATION

A. MODIFICATIONS

Notices of any modifications to this announcement will be posted on Grants.gov and the DOE Industry Interactive Procurement System (IIPS). You can receive an email when a modification or an announcement message is posted by joining the mailing list for this announcement through the link in IIPS. When you download the application at Grants.gov, you can also register to receive notifications of changes through Grants.gov.

B. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE

DOE reserves the right, without qualification, to reject any or all applications received in response to this announcement and to select any application, in whole or in part, as a basis for negotiation and/or award.

C. COMMITMENT OF PUBLIC FUNDS

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by other than the Contracting Officer, either explicit or implied, is invalid.

D. PROPRIETARY APPLICATION INFORMATION

Patentable ideas, trade secrets, proprietary or confidential commercial or financial information, disclosure of which may harm the applicant, should be included in an application only when such information is necessary to convey an understanding of the proposed project. The use and disclosure of such data may be restricted, provided the applicant includes the following legend on the first page of the project narrative and specifies the pages of the application which are to be restricted:

“The data contained in pages _____ of this application have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for evaluation purposes, provided that if this applicant receives an award as a result of or in connection with the submission of this application, DOE shall have the right to use or disclose the data herein to the extent provided in the award. This restriction does not limit the government’s right to use or disclose data obtained without restriction from any source, including the applicant.”

To protect such data, each line or paragraph on the pages containing such data must be specifically identified and marked with a legend similar to the following:

“The following contains proprietary information that (name of applicant) requests not be released to persons outside the Government, except for purposes of review and evaluation.”

E. EVALUATION AND ADMINISTRATION BY NON-FEDERAL PERSONNEL

In conducting the merit review evaluation, the Government may seek the advice of qualified non-Federal personnel as reviewers. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The applicant, by submitting its application, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign conflict of interest and non-disclosure agreements prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

F. INTELLECTUAL PROPERTY DEVELOPED UNDER THIS PROGRAM

Patent Rights. The government will have certain statutory rights in an invention that is conceived or first actually reduced to practice under a DOE award. 42 U.S.C. 5908 provides that title to such inventions vests in the United States, except where 35 U.S.C. 202 provides otherwise for nonprofit organizations or small business firms. However, the Secretary of Energy may waive all or any part of the rights of the United States subject to certain conditions. (See “Notice of Right to Request Patent Waiver” in paragraph G below.)

Rights in Technical Data. Normally, the government has unlimited rights in technical data created under a DOE agreement. Delivery or third party licensing of proprietary software or data developed solely at private expense will not normally be required except as specifically negotiated in a particular agreement to satisfy DOE’s own needs or to insure the commercialization of technology developed under a DOE agreement.

Special Protected Data Statutes. This program is covered by a special protected data statute. The provisions of the statute provide for the protection from public disclosure, for a period of up to five years from the development of the information, of data that would be trade secret, or commercial or financial information that is privileged or confidential, if the information had been obtained from a non-Federal party. Generally, the provision entitled, Rights in Data – Programs Covered Under Special Protected Data Statutes, (10 CFR 600 Appendix A to Subpart D), would apply to an award made under this announcement. This provision will identify data or categories of data first produced in the performance of the award that will be made available to the public, notwithstanding the statutory authority to withhold data from public dissemination, and will also identify data that will be recognized by the parties as protected data.

G. NOTICE OF RIGHT TO REQUEST PATENT WAIVER

Applicants may request a waiver of all or any part of the rights of the United States in inventions conceived or first actually reduced to practice in performance of an agreement as a result of this announcement, in advance of or within 30 days after the effective date of the award. Even if such advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver of the rights of the United States in identified inventions, i.e., individual inventions conceived or first actually reduced to practice in performance of the award. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.

Domestic small businesses and domestic nonprofit organizations will receive the patent rights clause at 37 CFR 401.14, i.e., the implementation of the Bayh-Dole Act. This clause permits domestic small business and domestic nonprofit organizations to retain title to subject inventions. Therefore, small businesses and nonprofit organizations do not need to request a waiver.

H. NOTICE REGARDING ELIGIBLE/INELIGIBLE ACTIVITIES

Eligible activities under this program include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

APPENDIX A – DEFINITIONS

“Amendment” means a revision to a solicitation.

"Applicant" means the legal entity or individual signing the Application. This entity or individual may be one organization or a single entity representing a group of organizations (such as a Consortium) that has chosen to submit a single Application in response to a solicitation.

"Application" means the documentation submitted in response to a solicitation. NOTE: Application is referred to as Proposal in IIPS.

“Authorized Organization Representative (AOR)” is the person with assigned privileges who is authorized to submit grant applications through Grants.gov on behalf of an organization. The privileges are assigned by the organization’s E-Business Point of Contact designated in the CCR.

"Award" means the written documentation executed by a DOE Contracting Officer, after an Applicant is selected, which contains the negotiated terms and conditions for providing Financial Assistance to the Applicant. A Financial Assistance Award may be either a Grant or a Cooperative Agreement.

"Budget" means the cost expenditure plan submitted in the Application, including both the DOE contribution and the Applicant Cost Share.

"Consortium (plural consortia)" means the group of organizations or individuals that have chosen to submit a single Application in response to a solicitation.

"Contracting Officer" means the DOE official authorized to execute Awards on behalf of DOE and who is responsible for the business management and non-program aspects of the Financial Assistance process.

"Cooperative Agreement" means a Financial Assistance instrument used by DOE to transfer money or property when the principal purpose of the transaction is to accomplish a public purpose of support or stimulation authorized by Federal statute, and Substantial Involvement (see definition below) is anticipated between DOE and the Applicant during the performance of the contemplated activity.

"Cost Sharing" means the respective share of Total Project Costs to be contributed by the Applicant and by DOE. The percentage of Applicant Cost Share is to be applied to the Total Project Cost (i.e., the sum of Applicant plus DOE Cost Shares) rather than to the DOE contribution alone.

“Central Contractor Registry (CCR)” is the primary database which collects, validates, stores and disseminates data in support of agency missions. Funding Opportunity Announcements which require application submission through Grants.gov require that the organization first be registered in the CCR at <http://www.grants.gov/CCRRegister>.

“Credential Provider” is an organization that validates the electronic identity of an individual through electronic credentials, PINS, and passwords for Grants.gov. Funding Opportunity Announcements which require application submission through Grants.gov require that the individual applying on behalf of an organization first be registered with the Credential Provider at <https://apply.grants.gov/OrcRegister>.

“Data Universal Numbering System (DUNS) Number” is a unique nine-character identification number issued by Dun and Bradstreet (D&B). Organizations must have a DUNS number prior to

registering in the CCR. Call 1-866-705-5711 to receive one free of charge.

http://www.grants.gov/applicants/request_duns_number.jsp

“E-Business Point of Contact (POC)” is the individual who is designated as the Electronic Business Point of Contact in the CCR registration. This person is the sole authority of the organization with the capability of designating or revoking an individual’s ability to submit grant applications on behalf of their organization through Grants.gov.

“E-Find” is a Grants.gov webpage where you can search for Federal Funding Opportunities in FedGrants. <http://www.grants.gov/search/searchHome.do>

“Federally Funded Research and Development Centers” (FFRDCs) conduct research for the United States Government. They are administered in accordance with U.S Code of Federal Regulations, Title 48, Part 35, Section 35.017 by universities and corporations. A list of FFRDCs can be found at <http://www.nsf.gov/statistics/nsf06316/>.

"Financial Assistance" means the transfer of money or property to an Applicant or Participant to accomplish a public purpose of support authorized by Federal statute through Grants or Cooperative Agreements and sub-awards. For DOE, it does not include direct loans, loan guarantees, price guarantees, purchase agreements, Cooperative Research and Development Agreements (CRADAs), or any other type of financial incentive instrument.

“Funding Opportunity Announcement (FOA)” is a publicly available document by which a Federal agency makes known its intentions to award discretionary grants or cooperative agreements, usually as a result of competition for funds. Funding opportunity announcements may be known as program announcements, notices of funding availability, solicitations, or other names depending on the agency and type of program.

"Grant" means a Financial Assistance instrument used by DOE to transfer money or property when the principal purpose of the transaction is to accomplish a public purpose of support or stimulation authorized by Federal statute, and no Substantial Involvement is anticipated between DOE and the Applicant during the performance of the contemplated activity.

“Grants.gov” is the “storefront” web portal which allows organizations to electronically find and apply for competitive grant opportunities from all Federal grant-making agencies. Grants.gov is THE single access point for over 900 grant programs offered by the 26 Federal grant-making agencies. <http://www.grants.gov>

“Industry Interactive Procurement System (IIPS)” is DOE’s Internet-based procurement system which allows access to DOE’s business opportunities database, allows user registration and submittal of Applications: <http://e-center.doe.gov/>.

"Key Personnel" means the individuals who will have significant roles in planning and implementing the proposed Project on the part of the Applicant and Participants, including FFRDCs.

“Marketing Partner Identification Number (MPIN)” is a very important password designated by your organization when registering in CCR. The E-Business Point of Contact will need the MPIN to login to Grants.gov to assign privileges to the individual(s) authorized to submit applications on behalf of your organization. The MPIN must have 9 digits containing at least one alpha character (must be in capital letters) and one number (no spaces or special characters permitted).

"Participant" for purposes of this Solicitation only, means any entity, except the Applicant substantially involved in a Consortium, or other business arrangement (including all parties to the Application at any tier), responding to the Solicitation.

"Project" means the set of activities described in an Application, State plan, or other document that is approved by DOE for Financial Assistance (whether such Financial Assistance represents all or only a portion of the support necessary to carry out those activities).

"Proposal" is the term used in IIPS meaning the documentation submitted in response to a solicitation. Also see Application.

"Pure Edge Viewer" is a small, free program which allows you to access, complete and submit applications electronically and securely through Grants.gov. You will not be able to access, complete, or submit an application through Grants.gov, unless the Pure Edge Viewer is downloaded on your computer. <http://www.grants.gov/DownloadViewer>.

"Recipient" means the organization, individual, or other entity that receives a Financial Assistance Award from DOE, is financially accountable for the use of any DOE funds or property provided for the performance of the Project, and is legally responsible for carrying out the terms and condition of the award.

"Selection" means the determination by the DOE Selection Official that negotiations take place for certain Projects with the intent of awarding a Financial Assistance instrument.

"Selection Official" means the DOE official designated to select Applications for negotiation toward Award under a subject solicitation.

"Substantial Involvement" means involvement on the part of the Government. DOE's involvement may include shared responsibility for the performance of the Project; providing technical assistance or guidance which the Applicant is to follow; and the right to intervene in the conduct or performance of the Project. Such involvement will be negotiated with each Applicant prior to signing any agreement.

"Total Project Cost" means all the funds to complete the effort proposed by the Applicant, including DOE funds (including direct funding of any FFRDC) plus all other funds that will be committed by the Applicant as Cost Sharing.

APPENDIX B – TECHNICAL TOPICS

TECHNICAL CHALLENGES

For transportation, the overarching technical challenge for hydrogen storage is how to store the amount of hydrogen required for a conventional driving range (greater than 300 miles), within the vehicular constraints of weight, volume, efficiency, safety, and cost. Durability over the performance lifetime of these systems, as well as acceptable refueling times and hydrogen delivery flow rates, must also be achieved. The key technical challenges for all approaches of vehicular storage include:

- **System Volume and Weight.** The volume and weight of hydrogen storage systems are presently too high, resulting in inadequate vehicle range compared to conventional petroleum fueled vehicles. Storage media, materials of construction and components are needed that allow compact, lightweight hydrogen storage systems while enabling a greater than 300-mile range in all light-duty vehicle platforms. Reducing weight and volume of thermal management components is also required.
- **System Cost.** The cost of on-board hydrogen storage systems is too high, particularly in comparison with conventional storage systems for petroleum fuels. Low-cost storage media, materials of construction and components for hydrogen storage systems are needed, as well as low-cost, high-volume manufacturing methods.
- **Efficiency.** Energy efficiency is a challenge for all hydrogen storage approaches. The energy required to get hydrogen in and out is an issue for on-board reversible materials. Life-cycle energy efficiency is a challenge for chemical hydrogen storage in which the spent fuel is regenerated off board the vehicle. Thermal management for charging and releasing hydrogen from the storage system needs to be optimized to increase overall efficiency for all approaches.
- **Durability/ Operability.** Durability of hydrogen storage systems is inadequate. Storage media, materials of construction and balance-of-plant components are needed that allow hydrogen storage systems with a lifetime of at least 1500 cycles and have tolerance to hydrogen fuel contaminants. An additional durability issue for material-based approaches is the delivery of sufficient quality hydrogen for the vehicle power plant.
- **Charging/ Discharging Rates.** In general and especially for on-board reversible and material-based approaches, hydrogen refueling times are too long. There is a need to develop hydrogen storage systems with refueling times of less than three minutes for a 5-kg hydrogen charge, over the lifetime of the system. Thermal management that enables quicker refueling is a critical issue that must be addressed. Also, all storage system approaches must be able to supply sufficient flow rate of hydrogen to the vehicle power plant (e.g. fuel cell or internal combustion engine) to meet the required power demand.
- **Thermal Management.** Approaches are needed to address heat input and removal requirements both during hydrogen charging and discharging for all technologies. In general, the main technical challenge is heat removal upon re-filling of hydrogen for on-board reversible materials within fueling time requirements. On-board reversible materials typically require heat to release hydrogen on board the vehicle. Heat must be provided to the storage media at reasonable temperatures to meet the flow rates needed by the vehicle power plant, preferably using the waste heat of the power plant. Depending upon the chemistry, chemical hydrogen approaches often are exothermic upon release of hydrogen to the power plant, or optimally thermal neutral. By virtue of the chemistry used, chemical hydrogen approaches may require significant energy to regenerate the spent material and by-products prior to re-use; this is done off the vehicle.
- **Codes & Standards.** Applicable codes and standards for hydrogen storage systems and interface technologies, which will facilitate implementation/commercialization and assure

safety and public acceptance, have not been established. Standardized hardware and operating procedures, and applicable codes and standards, are required.

- **Life-Cycle and Efficiency Analyses.** Systematic analyses for the full life-cycle cost, efficiency, and environmental impact for hydrogen storage systems are required.

Additional issues specific to reversible material-based hydrogen storage systems (i.e. materials that may be charged and discharged reversibly on board a vehicle) are:

- **Lack of Understanding of Hydrogen Physisorption and Chemisorption.** Fundamental understanding of hydrogen physisorption and chemisorption processes is lacking. Improved understanding and optimization of adsorption/absorption and desorption kinetics are needed to optimize hydrogen uptake and release capacity rates. An understanding of chemical reactivity and material properties, particularly with respect to exposure under different conditions (air, moisture, etc.) is also lacking.
- **Reproducibility of Performance.** Standard test protocols for evaluation of hydrogen storage materials are lacking. Reproducibility of performance both in synthesis of the material/media and measurement of key hydrogen storage performance metrics is an issue. Standard test protocols related to performance over time such as accelerated aging tests as well as protocols evaluating materials safety properties and reactivity over time are also lacking.

Additional issues specific to chemical hydrogen storage systems (i.e. materials that may discharge hydrogen on board but need to be regenerated off board) are:

- **Regeneration Processes.** Low-cost, energy efficient regeneration processes have not been established. Full life-cycle analyses need to be performed to understand cost, efficiency and environmental impacts.
- **By-Product/Spent Material Removal.** The refueling process is potentially complicated by removal of the by-product and/or spent material. System designs must be developed to address this issue and the infrastructure requirements for off-board regeneration.

The current status of various approaches are monitored continuously by DOE and compared to DOE system targets. Any proposed approaches should show potential to meet or exceed DOE's 2010 targets with potential to meet the 2015 targets.

GOALS AND TECHNICAL TARGETS

The goal of DOE's hydrogen storage applied research activity is to develop viable vehicular hydrogen storage technologies to meet the following key objectives:

- By 2010, develop and verify on-board hydrogen storage systems achieving 2 kWh/kg (6 wt.%), 1.5 kWh/Liter, and \$4/kWh.
- By 2015, develop and verify on-board hydrogen storage systems achieving 3 kWh/kg (9 wt.%), 2.7 kWh/Liter, and \$2/kWh.

Assuming no major changes in the basic vehicle platform designs, the 2010 targets would enable some vehicles to achieve a driving range of at least 300 miles, while the 2015 targets would enable virtually all of the light duty vehicle platforms to achieve this driving range. In other words, these targets were developed with the vision that systems meeting the 2010 targets would enable some degree of market penetration for hydrogen-powered vehicles, while systems meeting the 2015 targets would enable mass market penetration.

Table 1 shows the technical targets for on-board hydrogen storage systems⁵. The technical targets for on-board hydrogen storage systems were established through the FreedomCAR and Fuel Partnership between DOE, the U.S. Council of Automotive Research (USCAR), and five major energy companies⁶.

⁵ See the following websites for more details on the targets:

http://www1.eere.energy.gov/hydrogenandfuelcells/storage/pdfs/targets_onboard_hydro_storage.pdf and

<http://www.eere.energy.gov/hydrogenandfuelcells/mypp>.

⁶ The FreedomCAR and Fuel Partnership includes U.S. Department of Energy, USCAR (Chrysler LLC, Ford Motor Company and General Motors Corporation), BP America, Chevron Corporation, ConocoPhillips, ExxonMobil Corporation and Shell Hydrogen LLC.

Table 1 Technical Targets: On-Board Hydrogen Storage Systems

Storage Parameter	Units	2007	2010	2015
System Gravimetric Capacity: Usable, specific-energy from H ₂ (net useful energy/max system mass) ^a	kWh/kg (kg H ₂ /kg system)	1.5 (0.045)	2 (0.06)	3 (0.09)
System Volumetric Capacity: Usable energy density from H ₂ (net useful energy/max system volume)	kWh/L (kg H ₂ /L system)	1.2 (0.036)	1.5 (0.045)	2.7 (0.081)
Storage system cost ^b (& fuel cost) ^c	\$/kWh net (\$/kg H ₂) \$/gge at pump	6 (200) ---	4 (133) 2-3	2 (67) 2-3
Durability/Operability <ul style="list-style-type: none"> Operating ambient temperature^d Min/max delivery temperature Cycle life (1/4 tank to full)^e Cycle life variation^f Min delivery pressure from tank; FC= fuel cell, ICE=internal combustion engine Max delivery pressure from tank^g 	°C °C Cycles % of mean (min) at %confidence Atm (abs) Atm (abs)	-20/50 (sun) -30/85 500 N/A 8FC / 10ICE 100	-30/50 (sun) -40/85 1000 90/90 4FC / 35ICE 100	-40/60 (sun) -40/85 1500 99/90 3FC / 35ICE 100
Charging/discharging Rates <ul style="list-style-type: none"> System fill time (for 5 kg) Minimum full flow rate Start time to full flow (20 °C)^h Start time to full flow (- 20 °C)^h Transient response 10%-90% and 90% - 0%ⁱ 	min (g/s)/kW s s s	10 0.02 15 30 1.75	3 0.02 5 15 0.75	2.5 0.02 5 15 0.75
Fuel Purity (H ₂ from storage) ^j	% H ₂	99.99 (dry basis)		
Environmental Health & Safety <ul style="list-style-type: none"> Permeation & leakage^k Toxicity Safety Loss of useable H₂^l 	Sc/h - - (g/h)/kg H ₂ stored	Meets or exceeds applicable standards		
		1	0.1	0.05

Useful constants: 0.2778kWh/MJ, ~33.3kWh/gal gasoline equivalent.

Note: Above targets are based on the lower heating value of hydrogen and greater than 300-mile vehicle range; targets are for a complete system, including tank, material, valves, regulators, piping, mounting brackets, insulation, added cooling capacity, and/or other balance-of-plant components. Unless otherwise indicated, all targets are for both internal combustion engine and for fuel cell use, based on the low likelihood of power-plant specific fuel being commercially viable. Also note that while efficiency is not a specified target, systems must be energy efficient. For reversible systems, greater than 90% energy efficiency for the energy delivered to the power plant from the on-board storage system is required. For systems generated off-board, the energy content of the hydrogen delivered to the automotive power plant should be greater than 60% of the total energy input to the process, including the input energy of hydrogen and any other fuel streams for generating process heat and electrical energy.

Footnotes to Table 1

^a Generally the 'full' mass (including hydrogen) is used, for systems that gain weight, the highest mass during discharge is used.

^b 2003 US\$; total cost includes any component replacement if needed over 15 years or 150,000 mile life.

^c 2001 US\$; includes off-board costs such as liquefaction, compression, regeneration, etc; 2015 target based on H₂ production cost of \$2 to \$3/gasoline gallon equivalent untaxed, independent of production pathway.

^d Stated ambient temperature plus full solar load. No allowable performance degradation from -20C to 40C. Allowable degradation outside these limits is TBD.

^e Equivalent to 100,000; 200,000; and 300,000 miles respectively (current gasoline tank spec).

^f All targets must be achieved at end of life.

^g In the near term, the forecourt should be capable of delivering 10,000 psi compressed hydrogen, liquid hydrogen, or chilled hydrogen (77 K) at 5,000 psi. In the long term, it is anticipated that delivery pressures will be reduced to between 50 and 150 atm for solid state storage systems, based on today's knowledge of sodium alanates.

^h Flow must initiate within 25% of target time.

ⁱ At operating temperature.

^j The storage system will not provide any purification, but will receive incoming hydrogen at the purity levels required for the fuel cell. For fuel cell systems, purity meets SAE J2719, Information Report on the Development of a Hydrogen Quality Guideline in Fuel Cell Vehicles. Examples include: total non-particulates, 100 ppm; H₂O, 5 ppm; total hydrocarbons (C₁ basis), 2 ppm; O₂, 5 ppm; He, N₂, Ar combined, 100 ppm; CO₂, 1 ppm; CO, 0.2 ppm; total S, 0.004 ppm; formaldehyde (HCHO), 0.01 ppm; formic acid (HCOOH), 0.2 ppm; NH₃, 0.1 ppm; total halogenates, 0.05 ppm; maximum particle size, <10 μm, particulate concentration, <1 μg/L H₂. These are subject to change. See Appendix F of DOE Multiyear Research, Development and Demonstration Plan (www.eere.energy.gov/hydrogenandfuelcells/mypp/) to be updated as fuel purity analyses progress. Note that some storage technologies may produce contaminants for which effects are unknown; these will be addressed as more information becomes available.

^k Total hydrogen lost into the environment as H₂; relates to hydrogen accumulation in enclosed spaces.

Storage system must comply with CSA/NGV2 standards for vehicular tanks. This includes any coating or enclosure that incorporates the envelope of the storage system.

^l Total hydrogen lost from the storage system, including leaked or vented hydrogen; relates to loss of range.

THE NATIONAL HYDROGEN STORAGE PROJECT

The Department of Energy has conducted a series of workshops to identify R&D needs and to assess priorities and strategies for on-board hydrogen storage. These include a Hydrogen Storage Materials Workshop held in August 2002, a Hydrogen Storage “Think Tank” Meeting held in March 2003, and a Basic Energy Sciences Workshop held in May 2003. The proceedings of these workshops are available on DOE websites at

http://www.eere.energy.gov/hydrogenandfuelcells/wkshp_h2_storage.html;
http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/h2_storage_think_tank.pdf; and
http://www.sc.doe.gov/bes/reports/files/NHE_rpt.pdf.

Based on the findings from these workshops, the DOE issued a “Grand Challenge” to the scientific community for research in hydrogen storage in July 2003. This Grand Challenge called for the establishment of hydrogen storage Centers of Excellence in metal hydrides, chemical hydrogen storage, and sorbents, with multiple university, industry, and federal laboratory partners. In addition, independent projects were solicited on new materials and concepts, off-board hydrogen storage systems, and analyses of life cycle cost, performance and environmental impact. Complementing the Grand Challenge, the DOE Office of Science issued solicitations in 2004 and 2006 for basic research to improve fundamental understanding of materials and processes for hydrogen production, storage, and use.

The DOE Centers of Excellence and independent projects, together with existing DOE hydrogen storage efforts, constitute the framework of the National Hydrogen Storage Project. The Metal Hydride Center includes Sandia National Laboratory in Livermore, California and multiple university, industry and federal laboratory partners. The Metal Hydride Center focuses on the development of advanced metal hydride materials including light-weight advanced complex hydrides, destabilized binary hydrides, intermetallic hydrides, modified lithium amides, and other on-board reversible hydrides. The Chemical Hydrogen Storage Center includes the Los Alamos National Laboratory in Los Alamos, New Mexico, the Pacific Northwest National Laboratory in Richland, Washington, and multiple university and industry partners. The Chemical Hydrogen Center focuses on novel boron chemistry and innovation beyond boron. The Hydrogen Sorption Center includes the National Renewable Energy Laboratory in Golden, Colorado and multiple university, industry and federal laboratory partners. The Sorption Center focuses on breakthrough concepts to enable close to room temperature storage of hydrogen at nominal pressure. Current materials under consideration include high surface area adsorbents such as novel metal-carbon hybrids, carbon-boron materials, metal-organic framework materials, polymers, aerogels and other nanostructured high surface area materials. The National Hydrogen Storage Project also involves independent projects on new hydrogen storage materials and concepts, material and system testing, and system analyses.

In 2006, the DOE issued a Funding Opportunity Announcement and a National Laboratory Program Announcement to continue to solicit new ideas in storage materials and concepts from the R&D communities. Six projects addressing new storage materials and storage safety issues were selected from these two announcements. This announcement continues that effort to ensure that new storage materials and concepts are incorporated into the portfolio of the National Hydrogen Storage Project. In addition, the DOE’s Office of Science continues to issue solicitations for basic research to improve fundamental understanding of materials and processes for hydrogen production, storage, and use.

Further information on the DOE Hydrogen Program can be obtained from the Program website at <http://www.hydrogen.energy.gov>. EERE’s research plan and current portfolio can be found in the Hydrogen, Fuel Cells and Infrastructure Technologies Program’s Multi-Year Program Plan at <http://www.eere.energy.gov/hydrogenandfuelcells/mypp>, and from the Program’s Annual Progress Reports at http://www1.eere.energy.gov/hydrogenandfuelcells/annual_reports.html.

SCOPE OF ANNOUNCEMENT

DOE is requesting applications for the research and development of innovative technologies for on-board vehicular hydrogen storage systems.

The technical topic listed below is the only eligible research area under this announcement.

Materials Discovery

Research and development areas sought include new materials and concepts in the following areas: advanced metal hydrides, chemical hydrogen storage materials, carbon-based materials, high surface area sorbents including bridged catalyst (spillover) materials and conducting polymers, and other novel approaches. However, neither hydrolysis of sodium borohydride nor pure, undoped single-walled carbon nanotubes as on-board storage media are being solicited to be consistent with the Program's no-go decisions in these areas⁷.

Applications in these areas will not be reviewed. For chemical hydrogen storage materials, off-board regeneration must be considered and concepts to meet DOE efficiency goals should be submitted⁸. Applications for new materials with improved hydrogen storage gravimetric and volumetric capacity, hydrogen uptake and discharge kinetics, energy efficiency, operating temperature and pressure, cycle life, cost and durability of materials upon exposure to contaminants are appropriate. Development and application of new processes (such as mechanochemistry, sonochemistry, irradiation, electro/magnetism etc.) that can aid in the development of unique material properties (nanostructures, low cost manufacturing, etc.) are also applicable. Finally, the scope includes approaches for high throughput/combinatorial synthesis, screening and testing of storage materials and other novel characterization techniques that can aid in and be applied to the efficient discovery of new materials.

Research and development of cylindrical high pressure or liquid on-board storage tanks and off-board storage are not sought under this announcement and will not be reviewed. However, novel concepts for conformable tanks and approaches for moderate pressure (≤ 150 bar) hybrid systems may be proposed.

Objectives:

Project duration will typically be two to five years and consist of two phases, with overall project go/no-go decision points between the phases. The project schedule should take into consideration the meeting of key milestones in the Multi-Year Program Plan mentioned above.

Phase 1 is intended to explore new concepts, develop novel materials, and investigate material properties and hydrogen storage performance. The primary Phase 1 objectives are to assess the feasibility of new hydrogen storage materials and concepts and determine their potential to meet the DOE storage system performance targets. Results should be reproducible, and technical data reported to DOE should include, but are not limited to, weight and volume hydrogen capacity, hydrogen kinetics and thermodynamics.

⁷ See the following website for more information on the Program's no-go decisions:
http://www1.eere.energy.gov/hydrogenandfuelcells/hydrogen_publications.html#h2_storage.

⁸ For systems regenerated off-board, the regeneration efficiency goal is 60%, meaning that the content of the hydrogen delivered to the automotive power plant should be greater than 60% of the total energy input to the process, including the input energy of hydrogen and any other fuel streams for generating process heat and electrical energy.

Phase 2 is intended to pursue further development of promising materials identified during Phase 1 and continue to improve and optimize material performance. The primary Phase 2 objectives are to demonstrate improved material performance and properties that will determine the potential for meeting the DOE 2015 performance targets. Results should be reproducible, and technical data reported to DOE should include, but are not limited to, weight and volume hydrogen capacity, hydrogen kinetics and thermodynamics. An additional objective in Phase 2 for high capacity materials is to provide input to DOE relevant to the design and construction of storage systems, such as engineering data for cycle life, impurity tolerance, packing densities and packed bed thermal conductivity.

Material samples resulting from the R&D effort may be submitted for independent, standardized testing at a facility to be specified by DOE.

Cost share requirements:

Applicants must contribute a minimum of 20% of the total project cost, where the total project cost includes all applicant, subcontractor, and FFRDC costs.

It is intended that this announcement will be issued on an annual basis, subject to congressional appropriations. New projects will be selected each fiscal year based on technical merit review, program policy review and the availability of funds.

The potential for an applicant to become a member of an existing Hydrogen Storage Center of Excellence will be considered by DOE after selections are made and will have no effect on the evaluation and selection process. However, applicants may indicate in their application their desire to join one of the existing Centers. In such cases, the relevant Center should be mentioned, along with a brief description of how the proposed project can benefit from or complement the ongoing Center work.

The application process will include two phases -- a preliminary application phase and a final application phase. Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications.

To avoid duplication of current DOE-sponsored research in the relevant topic areas, the following information regarding current projects has been made available:

The Hydrogen Storage Program at <http://www.eere.energy.gov/hydrogenandfuelcells/storage>;

The DOE Hydrogen Program Annual Progress Reports at http://www1.eere.energy.gov/hydrogenandfuelcells/annual_reports.html;

The DOE Hydrogen Program Annual Program Merit Review and Peer Evaluation Reports at http://www1.eere.energy.gov/hydrogenandfuelcells/merit_review.html;

Target explanations at http://www1.eere.energy.gov/hydrogenandfuelcells/storage/pdfs/targets_onboard_hydro_storage.pdf and <http://www.eere.energy.gov/hydrogenandfuelcells/mypp/> ;

Ongoing Center of Excellence work at http://www.nrel.gov/basic_sciences/carbon_based_hydrogen_center.cfm; <http://www.ca.sandia.gov/MHCoE/>; and <http://www.chscpublic.ua.edu>