

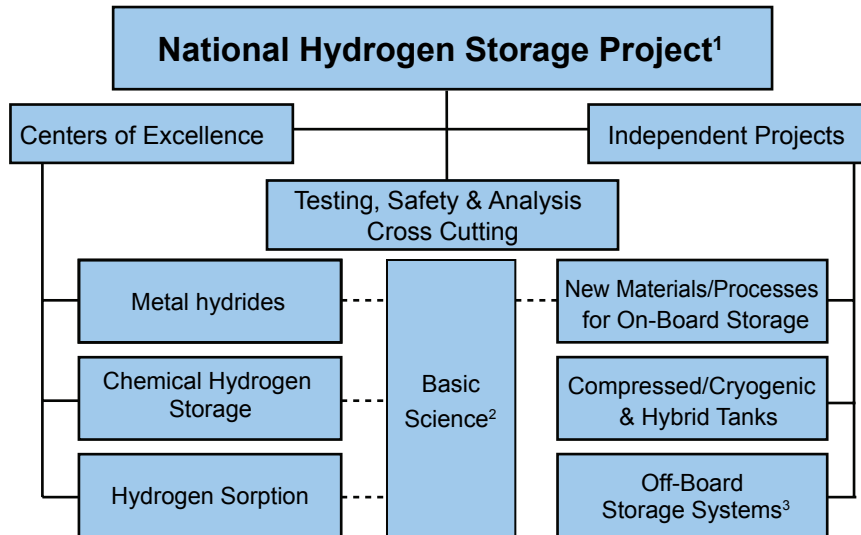
IV.0 Hydrogen Storage Sub-Program Overview

Introduction

Hydrogen storage for on-board transportation applications is one of the most technically challenging barriers to the widespread commercialization of hydrogen-fueled vehicles. The Hydrogen Storage activity focuses primarily on the research and development of low pressure, materials-based technologies to allow for a driving range of more than 300 miles while meeting packaging, cost, safety, and performance requirements to be competitive with current vehicles.

Figure 1 shows the framework for DOE's National Hydrogen Storage Project, which includes independent projects and three Centers of Excellence (CoE) in applied hydrogen storage R&D as well as basic science in hydrogen storage. Projects are focused in three main areas: metal hydrides, chemical hydrogen storage, and hydrogen sorption. Note that as a result of DOE's "no-go" decision on pure single-walled carbon nanotubes at the end of FY 2006, the CoE on Carbon-Based Materials has shifted its focus and is now the Hydrogen Sorption Center. In addition, a new cross-cutting area of material and system safety R&D was added in FY 2007 with three new competitively selected projects. The storage portfolio is comprised of approximately 40 universities, 15 companies and 10 federal laboratories, including 17 new basic science projects started in FY 2005 and seven new basic science projects awarded in FY 2007.

The Hydrogen Program continues to recognize the critical importance of hydrogen storage and agrees with the National Academies' recommendation that "...DOE should continue to elicit new concepts and ideas, because success in overcoming the major stumbling block of on-board storage is critical for the future of transportation use of fuel cells."¹



¹ Coordinated by DOE Energy Efficiency and Renewable Energy, Office of Hydrogen, Fuel Cells and Infrastructure Technologies

² Basic science for hydrogen storage conducted through DOE Office of Science, Basic Energy Sciences

³ Coordinated with Delivery Program element

FIGURE 1. Framework for the U.S. National Hydrogen Storage Project

¹ The Hydrogen Economy, Opportunities, Costs, Barriers, and R&D Needs, p. 44, National Academy Press, Washington, D.C. (2004).

Goal

The sub-program's overarching goal is to develop and demonstrate viable hydrogen storage technologies for transportation and stationary applications. The focus of the efforts have been on the near term targets of 1.5 kWh/kg (4.5 wt%), 1.2 kWh/L (36 g/L) and \$6/kWh, in addition to all other requirements such as durability, cycle life, and kinetics of hydrogen uptake and discharge. In addition, materials and concepts are sought to meet the longer term (2010) objective to enable significant market penetration of hydrogen-fueled vehicles based on achieving a driving range of more than 300 miles:

- Develop and verify on-board hydrogen storage systems achieving 2 kWh/kg (6 wt%), 1.5 kWh/L (45 g H₂/L), and \$4/kWh.

FY 2007 Technology Status

On-board hydrogen storage approaches under investigation include high capacity metal hydrides, high surface area sorbents, chemical hydrogen storage carriers, low-cost and conformable tanks, compressed/cryogenic hydrogen tanks, and new materials or processes, such as conducting polymers, and nanostructured materials. Physical storage systems, such as compressed/cryogenic tanks, and reversible material systems, such as metal hydrides and high surface area sorbents are classified as "on-board reversible" systems because they can be refueled on-board the vehicle from a gaseous (or liquid) hydrogen supply. For chemical hydrogen storage, as well as certain metal hydrides, material regeneration with hydrogen is not possible on-board the vehicle; thus, these systems must be regenerated off-board and are termed "regenerable off-board."

The current storage system status values, as shown below, are estimates provided by developers and by the R&D community and will be updated as new information continues to become available. Because a very limited number of full-scale complete systems have been fabricated, most of the data shown are projections based on system designs or on laboratory sub-scale prototypes. A key difference in Figure 2 compared to data from FY 2006, is the circle showing the range of "learning demo" system data from the DOE Technology Validation sub-program through which more than 70 hydrogen fuel cell vehicles have been independently validated. The majority of these vehicles used 5,000 psi (350 bar) hydrogen tanks (a small number used 10,000 psi or liquid tanks) and the storage system capacity ranged

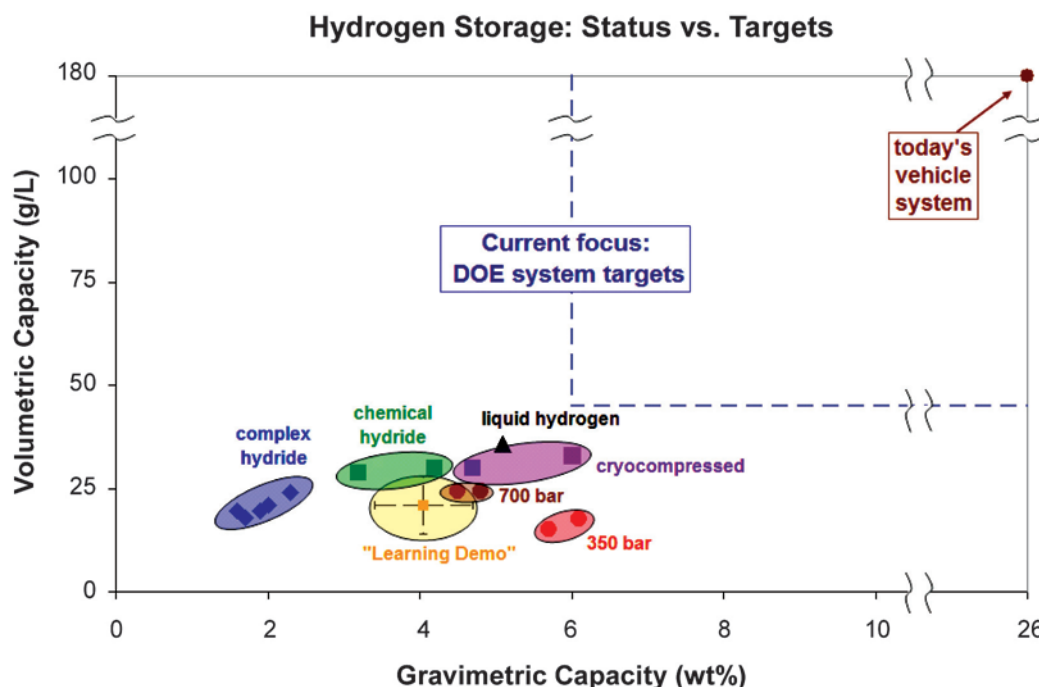


FIGURE 2. Current Status of Hydrogen Storage Systems versus Targets

from 3.5 to 4.7 wt% and 14 to 28 g/L. The driving range, based on EPA cycle data, was 103 to 190 miles. It is clear that none of the current systems meets the gravimetric or volumetric system targets. It should also be reiterated that there are several other requirements such as hydrogen charging and discharging rates that are not illustrated in Figure 2 and that must be met simultaneously with all other targets such as capacity.

FY 2007 Accomplishments

In FY 2007 the Hydrogen Storage sub-program continued to strengthen its robust portfolio of applied research and development projects and close coordination with the Office of Science basic research activity. An annual solicitation was implemented to ensure flexibility in rapidly adding promising new projects to complement the existing portfolio. As a result, six new competitively selected projects were awarded, including new materials and concepts such as polymers for hydrogen storage as well as reactivity and safety studies of storage materials. The organizations receiving new awards were: Argonne National Laboratory, Argonne, IL; Miami University, Oxford, OH; Sandia National Laboratories, Livermore, CA; United Technologies Research Center, East Hartford, CT (two projects); and the University of Hawaii, Honolulu, HI.

In addition, DOE is ensuring close coordination with other national and international efforts, to leverage technical talent worldwide, avoid duplication and help accelerate progress in hydrogen storage R&D. For example, the Hydrogen Storage sub-program worked closely with the Defense Logistics Agency on a new solicitation in their program which resulted in six new hydrogen storage projects that will be coordinated with the DOE effort. Figure 3 shows the progress in collaborative activities and how DOE's applied R&D program (Office of Energy Efficiency and Renewable Energy, EERE) interfaces with key partners to enable the ultimate development of commercially viable hydrogen storage technologies.

During FY 2007, a number of new materials were developed and the performance of earlier materials was improved through the CoE and independent projects. Within some projects, down-select decisions were made that eliminated specific materials based on performance criteria and work subsequently expanded on more promising approaches. Figure 4 shows gravimetric and volumetric material-based capacity data for materials under development in FY 2007. Note that these values do not include any balance-of-plant components needed to estimate system values. Although these

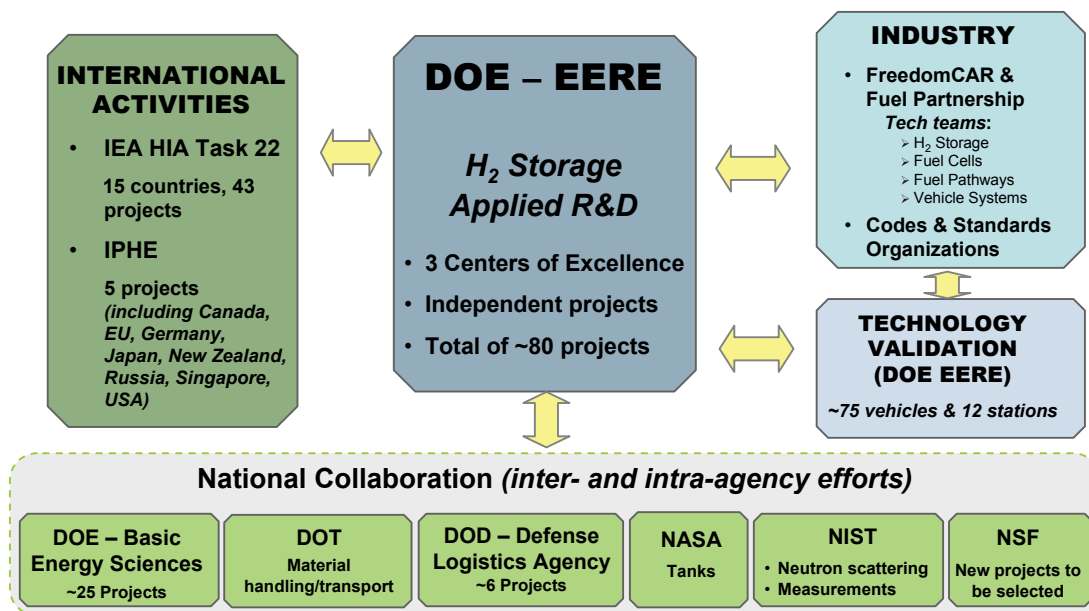


FIGURE 3. Hydrogen Storage Collaborations

	Metal Hydrides	Chemical H ₂ Storage	Adsorbents/Carbon
2006	<p>Alane ~8-10 wt%, ~150 g/L (<150 C) Borohydrides >9 wt%, ~100 g/L (~250 - 350 C) Destabilized Binary hydrides ~5-7 wt%, ~60-90 g/L (~250 C) Li Mg Amides ~5.5 wt%, ~80 g/L (>200 C)</p>	<p>4,7 Phenanthroline (organic liquids) ~7 wt%, ~65 g/L (<225 C) Seeded Ammonia Borane ~9 wt%, ~90 g/L (>120 C) Ammonia Borane/Li amide ~7 wt%, ~54 g/L (~85 C)</p>	<p>Metal-Organic Frameworks IRMOF-177 ~7 wt%, ~30 g/L (77K) Bridged catalysts/IRMOF-8 ~1.8 wt%, ~10 g/L (room temperature) Metal/carbon hybrids, MetCars (*theory) ~6-8 wt%*, ~39 g/L*</p>
2007	<p>Alane (AlH₃) regeneration Chemical, electrochemical, supercritical fluids</p> <p>LiBH₄/C aerogels 6-8 wt%, ~55-75 g/L (~300 C)</p> <p>Reversible Ca(BH₄)₂ ~9.6 wt%, ~105 g/L (~350 C) Mn(BH₄)₂ 9-13 wt% (>100 C) Mg(BH₄)₂ 9-12 wt%, ~110 g/L (~350 C)</p> <p>Destabilized hydrides DFT identified new reactions LiBH₄/MgH₂, CaH₂/LiBH₄, LiNH₂/LiH/Si</p>	<p>1,6-Naphthyridine ~7 wt%, ~70 g/L (275 C) Surface supported catalyst</p> <p>Amine boranes Ionic liquids ~7 wt%, 39 g/L (85 C) AB/LiNH₂, AB/LiH ~9 wt%, ~70 g/L (85 C) Solid AB >16 wt%, >199 g/L (155 C) (>3g/s/kgAB) Liquid AB/catalyst ~6 wt% (~80 C) Regeneration 2 step process, est.>50% eff.</p>	<p>Bridged cat./IRMOF-8 >3 wt%, 100 bar (25 C) ~20 kJ/mol Bridged cat./AX-21 >1 wt%, 100 bar (25 C)</p> <p>C aerogels ~5 wt%, ~30 g/L (77 K) Metal-doped C aerogels ~2 wt.% (77 K) ~7-7.5 kJ/mol</p> <p>PANI 2.8 wt%, 25 bar (25 C) Release at ~100-220 C</p>

* Estimated

FIGURE 4. Selected Examples of Progress in Applied Materials R&D in FY 2007 (Note: Material Capacities Only, Not System Capacities)

promising results show potential materials-based capacities of over 5 to 9 wt% and over 45 g/L, it must be reiterated that the targets are *system*-level capacities that include the storage media, tank and all balance-of-plant components needed for a vehicular system.

Significant work is still needed to modify or “tune” the properties of high hydrogen capacity materials toward the required range of operating temperatures and pressures. Much of the work this fiscal year was focused on this issue. While most researchers and technical articles show plots of storage capacity (weight versus volume), an informative alternative is to show capacity as a function of temperature. Figure 5 shows the current status of materials development from the Hydrogen Storage sub-program activity in terms of hydrogen capacity (material-based capacity on a weight basis) as a function of release or uptake temperature. The *system* level targets for weight and temperatures are defined by the dashed lines to put the material-based capacities in perspective. The limitations in temperature are mainly due, in some materials, to thermodynamic properties (e.g., enthalpies or binding energies are either too high or too low) and in other materials the kinetics (e.g., hydrogen absorption or release rates) are too slow at the required operating temperatures. It should also be noted that there is typically a range of temperatures across which hydrogen is discharged (or charged) and the values shown will be periodically updated by DOE as advancements are made in this rapidly progressing field.

Selected Examples of FY 2007 Accomplishments

Advanced Metal Hydrides

- Progress on incorporating borohydrides into nanoporous scaffolds has continued and significant performance improvements were demonstrated with LiBH₄ incorporated into a carbon aerogel structure (T. Baumann, Lawrence Livermore National Laboratory, member of the Hydrogen Sorption CoE). The capacity penalty found with other scaffold materials was significantly reduced,

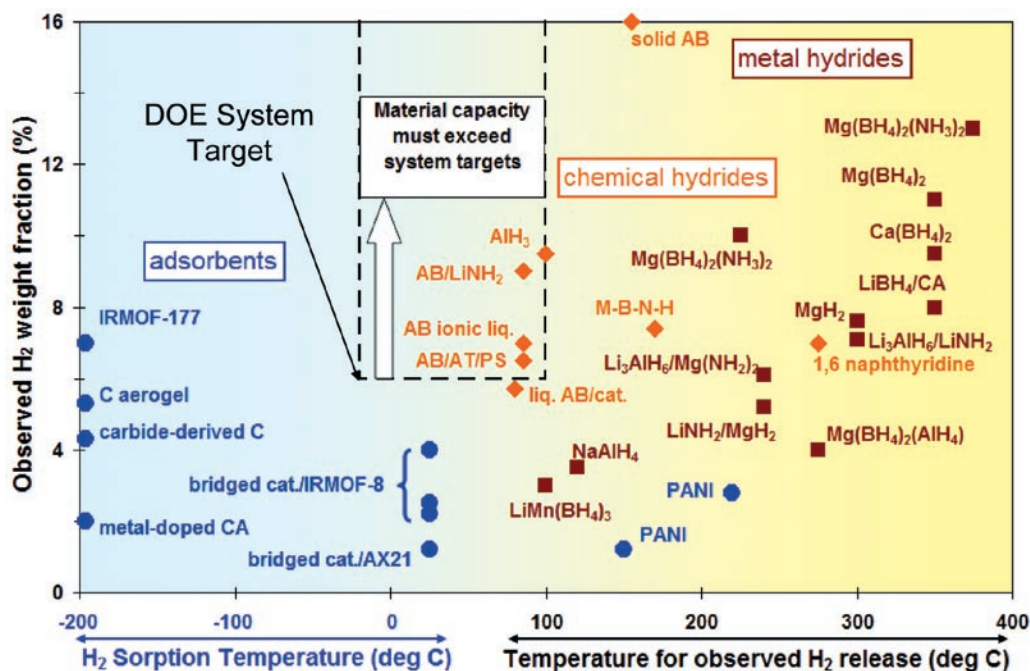


FIGURE 5. Hydrogen Storage Capacity for Materials Developed through the Program as a Function of Temperature

resulting in an overall 8 wt% H_2 material storage capacity. Furthermore, at 300°C the reaction rate was >150X faster than the borohydride alone and the equilibrium pressure was increased by a factor of ~10. (J. Vajo and G. Olson, HRL, member of the Metal Hydride CoE) This is one of the examples of cross-center collaboration.

- The reaction enthalpies of ~340 dehydrogenation reactions were calculated using density functional theory (DFT) and published. From the ~340 calculations, 15 reactions were predicted to have enthalpies in the range for practical on-board hydrogen storage materials. This work has the potential to significantly reduce the amount of trial and error typically experienced in new materials discovery research and allows experimentalists to focus on the most promising options. (S. Alapati, J. K. Johnson, University of Pittsburgh and D. S. Sholl, Carnegie Mellon University, members of the Metal Hydride CoE)
- A Monte Carlo method developed last year which enables one to estimate the enthalpies of compounds without a knowledge of their crystal structures was applied to identify a promising borohydride, $Ca(BH_4)_2$, with high capacity (~9.6 wt%). This material was subsequently synthesized and experimentally shown to demonstrate reversibility at 700 bar hydrogen pressure. (E. Ronnebro and E. Majzoub, Sandia National Laboratories, member of the Metal Hydride CoE)
- Combinations of alanates and amides, specifically combinations of Li-Al-Mg-N-H, have been shown to have improved thermodynamic properties over the individual compounds. One of the more promising combinations are $MgH_2/LiNH_2$, which has been studied previously, was shown to have a reversible hydrogen capacity of ~5 wt% and with hydrogen release and uptake starting at >100°C. Another combination with improved properties is $Li_3AlH_6/Mg(NH_2)_2$ with a demonstrated reversible ~6 wt% capacity and release/absorption at ~200°C. (Z. Fang and H.Y. Sohn, University of Utah, member of the Metal Hydride CoE)
- Mg borohydride has been extensively studied and methods to improve the material's performance have been found. First, the crystal structure of $Mg(BH_4)_2$ was determined, which will enable more accurate modeling of material properties. Secondly, effective catalyst precursors were found through combinatorial screening methods. Finally, a new borohydride material, $Mg(BH_4)(AlH_4)$, with 11.2 wt% H_2 theoretical material-based capacity was synthesized. Hydrogen desorption starts in this new material at ~100°C and is complete at ~250°C. (J.C. Zhao, et al., GE Global Research, member of the Metal Hydride CoE)

- Several approaches are being pursued in parallel to regenerate alane, AlH_3 , and important progress has been made. Liquid organometallic routes were shown to enable the formation of alane from “activated” Al with hydrogen pressures of ~35 bar at room temperature (300 K). The process can yield essentially 100% conversion and is promising from an energy cost standpoint; one of the remaining issues is to separate the alane from the organometallic without decomposition. (J. Graetz, J. Riley and J. Wegrzyn, Brookhaven National Laboratory, member of the Metal Hydride CoE)

Chemical Hydrogen Storage

- Researchers at Air Products and Chemicals developed a new family of organic carriers based on beta-carboline, with lower enthalpies of hydrogenation averaging at 10.4 kcal/mol H_2 (~43 kJ/mol) as compared to 11.3 kcal/mol H_2 (~47 kJ/mol) for previously developed N-ethylcarbazole. However, catalyst activity was limited at the lower temperature and work is needed on more active catalysts. A significant improvement in catalyst efficiencies for wash coat catalysts (~8X higher than pellets) was also demonstrated. (A. Cooper, et al., Air Products and Chemicals)
- Extensive studies of ammonia borane (AB) hydrogen release were performed which indicated that pure AB exhibits many desirable properties as a hydrogen storage material. At 155°C, the hydrogen release corresponds to ~16 wt% H_2 and 48 g H_2 /L (material-based capacities). The release rate at this temperature has potential to meet the hydrogen release rate requirements with less than a kg of material. (T. Autrey, et al., Pacific Northwest National Laboratory, member of the Chemical Hydrogen Storage CoE)
- A new approach based on the chemical promotion of AB dehydropolymerization in ionic liquids with a proton sponge was demonstrated that results in a faster (more than 3X) and greater extent (~2X) of hydrogen release at 85°C while prohibiting the production of unwanted side products. (L. Sneddon, University of Pennsylvania, member of the Chemical Hydrogen Storage CoE)
- Liquid AB fuel compositions (AB/methylamine borane mixtures) were developed that have comparable performance to other AB systems. (C. Lane, Northern Arizona University, T. Baker et al., Los Alamos National Laboratory, K. Goldberg, et al., University of Washington, members of the Chemical Hydrogen Storage CoE)
- Proof-of-principle experiments demonstrated the regeneration of ammonia borane from spent AB fuels, avoiding the generation of B-O bonds using two different chemical approaches with theoretical thermodynamic efficiencies approaching 60%. Progress was made on individual steps in the multi-step process for ammonia borane regeneration. Digestion and disproportionation of spent AB was shown to occur at room temperature with t-BuOH in a closed vial; and a six-fold increase in yield was found with an overpressure of NH_3 . Theoretical estimates are being used to guide future work in this area. (F. Stephens et al., Los Alamos National Laboratory, L. Sneddon, University of Pennsylvania, D. Dixon, University of Alabama, and D. Camaioni, Pacific Northwest National Laboratory, members of the Chemical Hydrogen Storage CoE)
- Within a new International Partnership for the Hydrogen Economy (IPHE) project, progress is being made on a new class of high capacity materials, metal amine-borane compounds. One M-B-N-H compound with a formula weight capacity of 10 wt% H_2 was shown to release ~7 wt% H_2 at ~170°C. (T. Burrell, et al., Los Alamos National Laboratory and T. Autrey, et al., Pacific Northwest National Laboratory, members the Chemical Hydrogen Storage CoE)
- A comprehensive analysis of sodium borohydride regeneration options was completed that identified a series of chemical pathways (metal reduction, electrochemical and carbothermal/elemental) and a comparison of their regeneration energy efficiencies as well as environmental, supply/demand logistics, raw material requirements and cost factors. This work will be an important contribution to the upcoming go/no-go decision on sodium borohydride for hydrogen storage. (S. Linehan, et al., Rohm and Haas Co., member of the Chemical Hydrogen Storage CoE)

Hydrogen Sorption

- Room temperature hydrogen storage sorbents with bridged catalysts (spillover) developed and demonstrated by Ralph Yang (University of Michigan) in FY 2006, were independently synthesized

and tested. A capacity of ~1.2 wt% H₂ was demonstrated in AX-21 (activated carbon) with a bridged catalyst, roughly double the capacity of this material without the bridged catalyst. A capacity of ~2.5 wt% H₂ was reproducibly measured by Southwest Research Institute (SwRI) for a metal organic framework material (IRMOF-8) with a bridged catalyst at room temperature and ~70 bar pressure. The volumetric density was estimated to be ~40 g H₂/L. This sample was prepared by INER (Taiwan) using Yang's published procedure, previously developed as part of the Hydrogen Sorption CoE. These capacity data are consistent with Yang's earlier results on bridged catalyst IRMOF-8 (up to ~4 wt% at ~100 bar) and indicate the highest room temperature capacity adsorbent material reported to date. (M. Miller, SwRI and INER, R. T. Yang, et al., University of Michigan, P. Parilla, et al., National Renewable Energy Laboratory, members of the Hydrogen Sorption CoE)

- Hydrogen uptake and release was observed in a conducting polymer, polyaniline (PANI), prepared by the University of Pennsylvania group (led by the late A. MacDiarmid). A hydrogen release of ~2.8 wt% H₂ was measured at ~200°C in a sample charged at ~25 bar. Although the measured capacity was not as high as the ~6 wt% value reported by Cho, et al., CNU (Korea), it represents an important verification of the earlier published results and suggests that this class of materials should be explored further for their potential as a hydrogen storage material. (P-C Wang, et al., University of Pennsylvania, with partners University of Texas-Dallas, University of Houston, members of the Hydrogen Sorption CoE)
- By adapting a method used in lithium-ion battery fabrication, the volumetric capacities of carbide-derived-carbon (CDC) powders were increased by up to ~100%, with only a 10-30% increase in weight. In this approach, poly-tetrafluoroethylene (PTFE) was used to bind CDC powders compressed into a rolling peel. The density could be further increased by forming pellets from the peels. With 2-5% PTFE, the overall material density was increased from 0.4 g/cc to 0.8 g/cc, while the overall weight density decreased from ~3.4 wt% H₂ for the powder to ~3 wt% for the compacted material at 77 K and 30 bar. (J. Fischer, University of Pennsylvania; Y. Gogotsi, Drexel University, and T. Yildirim, National Institute of Standards and Technology)
- Boron-doped carbon materials (B/C materials) were successfully synthesized with doping levels as high as 8 atomic % boron. Measurements on a 6.5 atomic % B/C sample with a modest surface area of 780 m²/g, indicated ~3 wt% H₂ capacity at 77 K and 30 bar, compared to ~1.5 wt% H₂ for activated carbon of comparable surface area and charging conditions. (M. Chung, et al., Penn State University, member of the Hydrogen Sorption CoE)
- Carbon aerogels (CA) have been shown to be an effective high surface area adsorbent for low temperature hydrogen uptake. An activated carbon aerogel was made with the highest surface area, ~3,200 m²/g, ever reported for these materials. The excess hydrogen capacity measured at 77 K and 25 bar was ~5.3 wt% H₂, with a volumetric capacity of ~29 g H₂/L. The binding energy in these materials was determined to be ~6 kJ/mol H₂, slightly higher than that typically found for carbon materials. A cobalt-doped CA was also prepared, which had a binding energy of ~7.5 kJ/mol H₂. (T. Baumann, et al., Lawrence Livermore National Laboratory, member Hydrogen Sorption CoE)

Compressed and Cryogenic Tanks

- Lawrence Livermore National Laboratory demonstrated their "cryo-compressed" hydrogen concept by fabricating and testing a 10.7 kg hydrogen cryo-compressed tank mounted on-board a vehicle converted to run on hydrogen. Assuming that all of the hydrogen in the tank is accessible and using the weight and volume of the inner and outer tank assemblies, thermal insulation and other ancillary components (valves, regulators, mounting hardware, fill tubes, etc.), the overall storage weight and volume densities were determined to be 6 wt% H₂ (2 kWh/kg) and 33 g H₂/L (1.1 kWh/L). An assessment by Argonne National Laboratory (R. Ahluwalia) with input from developers and DOE's Systems Integrator, calculated a capacity of 4.7 wt% and 30 g/L for the above system. (S. Aceves, et al., Lawrence Livermore National Laboratory)

Testing, Safety and Analysis

- A system level analysis of the dehydrogenation reactor for an onboard organic liquid carrier system (organic liquid carriers are being developed by Cooper, et al., Air Products and Chemicals) was

completed. Based on a specific trickle-bed reactor design and published kinetic data for carrier plus catalyst, estimates were made of the system performance for materials with a range of hydrogen capacities and enthalpies. An example is that the 2010 weight and volume targets could potentially be met with a ~8.5 wt% H₂ liquid carrier with an enthalpy of <40 kJ/mol H₂. For n-ethylcarbazole, the carrier studied by Air Products in FY 2006, the system capacity was projected to be 2.8 wt% (and 23 g/L) when including the hydrogen that would have to be burned. (R. Ahluwalia, et al., Argonne National Laboratory)

- A best practices document was prepared to disseminate critical issues in the accurate testing of hydrogen storage materials. This document was considered to be valuable to the global hydrogen storage R&D community, particularly to the large number of new researchers in the field, and communicates measurement techniques, potential issues and lessons learned. (K. Gross, HyEnergy and National Renewable Energy Laboratory)
- Two new projects were initiated to identify the risks associated with hydrogen storage materials and systems. These two projects will be closely coordinated with the continuing IPHE hydrogen storage safety project (D. Anton, Savannah River National Laboratory), initiated in FY 2006. One project will investigate the reactivity of promising hydrogen storage materials under different scenarios including various levels of air and water exposure (D. Dedrick, Sandia National Laboratory). The second project will perform risk analyses of hydrogen storage materials and systems and will investigate mitigation strategies. (D. Mosher, United Technologies Research Center)

FY 2008 Plans and Budget

The funding portfolio for Hydrogen Storage emphasizes materials R&D to meet system targets for on-board applications with a focus on alternatives to high-pressure or cryogenic tanks. The requested EERE FY 2008 funding profile (subject to congressional appropriations), which includes the CoE and independent projects, continues to address the National Academies' recommendations and the FreedomCAR and Fuel Partnership goals. While most of the effort is on novel, potentially breakthrough materials, continued support at a low level is for compressed hydrogen/cryogenic tanks emphasizing cost reduction, novel conformable designs, and advanced tank concepts with potential to accelerate early market penetration and container approaches that may be applicable to materials-based storage approaches.

Subject to congressional appropriations, the Hydrogen Storage sub-program will conduct its annual solicitation to select approximately three to six new awards that will start in FY 2008. A solicitation new CoE on engineering sciences is planned, to focus on engineering and system issues including thermal management, with up to \$2 million anticipated to be allocated in FY 2008. The chart below illustrates the funding in FY 2007 for each major activity along with planned funding in FY 2008 based on the Program's

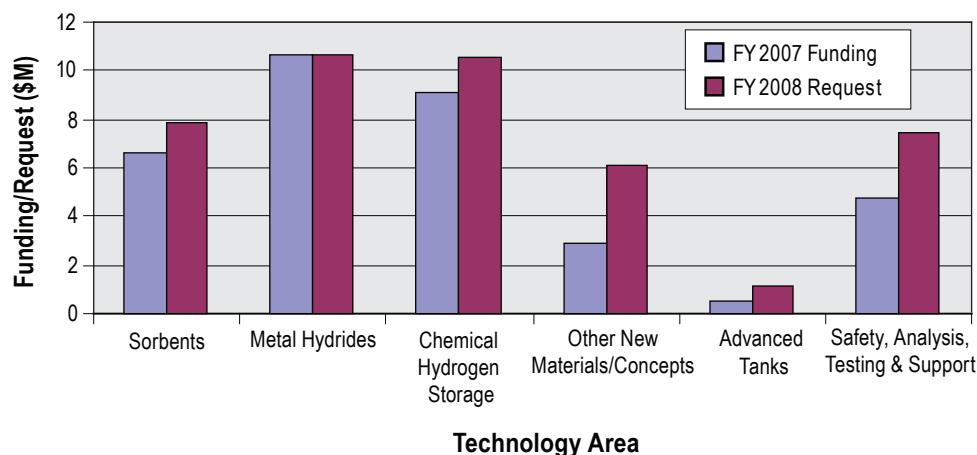


FIGURE 6. FY 2007 Funding and Planned FY 2008 Funding Based on Budget Request

budget request. In addition, depending on the result of DOE's go/no-go decision on sodium borohydride planned for the end of FY 2007, adjustments to the portfolio may be made.

The applied R&D on advanced metal hydrides, chemical hydrogen storage, and sorbent-based materials will continue with the planned strategies as described in the FY 2006 report. It should be emphasized that the sub-program will not focus only on storage capacity but is considering a number of other factors such as kinetics, hydrogen uptake and discharge temperatures, and overall system efficiency as well as life cycle cost. Tailoring materials to meet the required rates at practical temperature and pressure conditions is the primary focus of the FY 2008 portfolio. Because prior work in the global R&D community has focused primarily on metal hydrides and more recently on sorbent-based materials, with minimal attention paid to chemical hydrogen storage, a critical research area in FY 2008 will be on regeneration chemistry for chemical hydrogen storage. A key milestone planned for FY 2008 is to demonstrate chemical hydrogen storage regeneration methods at the laboratory scale, obtain initial data for efficiency and cost analysis, and demonstrate lab-scale reactions capable of at least 40% energy efficiency.

The new area of storage materials and system safety and risk mitigation will continue, with close coordination through an IPHE project and with DOE's CoE and independent projects. The independent systems analysis efforts will include an assessment of alane and other chemical hydrogen storage approaches. The coordination with basic science, including theory, characterization and novel concepts will continue to be expanded in FY 2008, with a follow on to the EERE-Basic Energy Sciences workshop in FY 2006 on theory and modeling for hydrogen storage materials. In addition, emphasis will be placed on the use of combinatorial/high throughput techniques where applicable. Details from the workshop conducted in FY 2007 can be found at: http://www1.eere.energy.gov/hydrogenandfuelcells/mtg_storage_materials.html.



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