

**APPENDIX E: FY 2006 MERIT REVIEW AND PEER EVALUATION MEETING:
SUBPROGRAM EVALUATIONS**

During the first-day Plenary Session and at the beginning of each Subprogram track, Team Leads presented overview briefings of their Subprogram areas. The Peer Reviewers were provided an evaluation form, different from the one they used to evaluate individual projects, on which to provide comments on these overviews and the overall Subprogram. (The actual evaluation form is provided in Appendix D). These evaluations were voluntary, so the number of responses varied widely across the Subprograms.

The specific questions asked of the Reviewers were:

1. Was the Subprogram area adequately covered and/or summarized?
2. Were important problem/issue areas and challenges identified/discussed, including plans for addressing these items in the future?
3. Does the Subprogram area appear to be focused, managed well, and effective in addressing the Hydrogen Program R&D needs?
4. Other comments.

Following are consolidated summaries of the responses received for these Subprogram Evaluations.

Project # AN: Systems Analysis

Fred Joseck

Degree to which the Subprogram area was adequately covered and/or summarized

- A very good brief overview of the program.
- A good summary of achievements.
- A map of how the models fit with respect to the modeling needs and identification of what objectives each model is targeting would be helpful.
- Fred provided a very clear explanation of the Analysis subprogram. Overview was at an adequate level and complemented the presentations very well.
- Covered well—Goals and Objectives were clear and appropriate.
- One thing not clear was the extent of comparison of various hydrogen scenarios with non-hydrogen scenarios for alleviation of petroleum shortages.
- In addition, there was very little discussion of how these analyses will be used in down-selecting various hydrogen approaches for production, delivery, and other aspects of well-to-wheel utilization.
- Not clear whether need for carbon dioxide reduction is being included as a major driver in the various analyses (assuming sequestration at the hydrogen generation site).

Were important problem/issue areas and challenges identified/discussed, including plans for addressing these items in the future?

- The models are generally providing analysis of the transition to hydrogen adoption.
- The models don't appear to be as well suited to R&D investment decisions. Perhaps a decision programming approach could be used to assess R&D investments.
- The inclusion of plug in hybrid vehicle technology would be useful in a number of models.
- Challenges and barriers were identified and the approach to plugging those holes was described.
- Mostly yes.
- Market demand issue was not adequately addressed.
- Feedstock pricing volatility impacts need to be examined.
- There is some question in my mind as to whether considering SMR as reducing petroleum usage is appropriate inasmuch as I would tend to lump petroleum and SMR-derived hydrogen in the same bucket (I realize that this can be argued).

Does the Subprogram area appear to be focused, managed well, and effective in addressing the Hydrogen Program R&D needs?

- The program is clearly focused on the overall program needs.
- The Resource Centre and the H2A model are starting to provide a strong backbone for the analysis effort.
- There appears to be overlap between the various models currently being developed.
- Program is well managed, but like other areas, faces the dilemma of having more needs than resources to satisfy those needs. Models being developed and exercised are good "first cuts", but as time and funding permits, they must be refined. Second order impacts on cost, demand, market penetration, etc., must be included in the models to provide a realistic forecast and a better guide for R&D in the other technology areas.
- Yes.

Other comments:

- The basis for assessing R&D investment decisions is not clear – consideration could be made of using a decision making model framework – perhaps as a layer over the MSM.
- The adoption of cost, energy security and GHG measures across the model would be helpful.
- The modeling of plug in hybrids may be needed across a number of models.

- In the presentation, it is surprising that distributed hydrogen production using wind is assessed to have similar emissions to gasoline vehicles. Is fossil fuel consumption assumed here in order to increase electrolyzer duty? There may be other distributed wind configurations.
- Slide 14 shows the energy security and GHG factors well – these objectives don't appear to be always the objectives of the models that have been developed. Cost is generally the objective but perhaps a constraint should be placed on the models to achieve outcomes with the low GHG and low gasoline.
- The Systems Analysis area is to be complemented for resisting the temptation of simply jumping in and starting projects. It has taken a more organized approach of identifying the holes, filling those holes and then reevaluating the status as technology progresses. Plans for a crosscut analysis team are also important to assure consistency in EERE message to stakeholders.
- For whatever it's worth, I feel that AN-05 and AN-07 are very strong efforts and should be retained and possibly expanded.
- AN-01 and AN-03 also appear to contribute significant value, but I feel that the other four efforts could be discontinued to permit expansion on AN-05 and AN-07 (assuming that you are budget-constrained).

Project # ED: Hydrogen Education

Christy Cooper

Degree to which the Subprogram area was adequately covered and/or summarized

- The program overview was very clear and focused; nice presentation.
- Good overview of future direction. A wrap-up of closed out projects would help. What happened? For example, what is the status of the Hydrogen Learning Centers? For those who only see the whole program effort once a year, this gives continuity.

Were important problem/issue areas and challenges identified/discussed, including plans for addressing these items in the future?

- Between the program overview presentation and Baseline Survey presentation given at lunch, the issues and delays are very clear; there seems to be more incorrect information than knowledge of hydrogen.
- Budget issues clearly presented. Baseline information clearly presented the challenge.

Does the Subprogram area appear to be focused, managed well, and effective in addressing the hydrogen program R&D needs?

- The program is focused on raising “H₂IQ.” It is well managed but constrained by budget.
- A lot is being done with very little funding. We need to have a full, uncut hydrogen education budget year.

Other comments:

- Priorities are appropriate for level of funding but there is so much more that needs to be done now.

Project # FC: Fuel Cells*Valri Lightner / Nancy Garland***Degree to which the Subprogram area was adequately covered and/or summarized**

- The sub-program was well covered, including barriers, targets, sub-topics and tasks.
- Activities in the subprogram area were clearly summarized with good enthusiasm.
- Between the posters, talk, and the program review, most issues were covered well.

Were important problem/issue areas and challenges identified/discussed, including plans for addressing these items in the future?

- Revisions to the RD&D plan are being considered to modify the barriers and tasks.
- The Subprogram focuses on a very broad scope of issues, not all of which are of a primary importance. Especially in the context of rather limited resources, the Subprogram could benefit from prioritizing tasks and focusing on materials with an enabling role for the introduction of fuel cells to automotive transportation. Components crucial to the ultimate success of PEFCs for transportation, such as cathode catalysts, catalyst supports, membranes, and MEAs should be developed first, before significant effort and resources are invested in other areas.
- What is the impact of a fast, steady growth of in the Pt price on the technical targets established using Pt price less than half of what it is today? There might be a need for a new comprehensive analysis of the impact of the growing price of Pt on technical targets of the Program.
- Balance of plant not covered adequately.

Does the Subprogram area appear to be focused, managed well, and effective in addressing the Hydrogen Program R&D needs?

- Yes. I believe the current focus on partnering (industry, National Labs, etc.) and peer review will further advance the programs.
- Some Projects might benefit from consolidation with other closely related programs - in order to better establish "critical mass" and better utilize resources and funding. A method of "consolidation" might be to establish "program matrix" or "interactions" for certain topics, to encourage additional collaboration between the Projects. From the presentations - I can already see this in many of the National Lab projects. There may be additional opportunities with industry, trade organizations, etc.
- The sub-program is well focused and has put go/no-go decision points into many of the projects.
- The program is well managed. Is large funds for some of the industrial projects justified?

Other comments:

- After listening to the Catalyst Projects, one thought - a "summary/compilation" project would be useful to consolidate the findings, developments, etc., - since many of these programs are coming to an end. This "summary" would update any "revisions to theory" (as validated by more recent studies, etc.) and provide a useful guide for "going forward". In the past, this might appear in "The Fuel Cell Handbook" update edition. It would be well spent support money for the DOE program - particularly if assigned to respected colleagues from the Catalyst projects.
- The sub-program is also incorporating some of the recommendations that came from the NRC's review of the FreedomCAR & Fuel Partnership.
- Traditionally, the Annual Review includes projects with very different funding levels, often reviewed one after another. This may put projects with less funding in an inferior position, regardless of the quality of the work done.
- A very low funding level for some projects (a fraction of an FTE) has effectively prevented good quality work from being done. Projects with clearly insufficient, almost "symbolic" funding should be terminated.
- Lunches ought to be reserved for discussion and networking.
- DOE should not fund laboratories merely to test materials developed by others.

Project # PD: Production and Delivery

Patrick Davis

Degree to which the Subprogram area was adequately covered and/or summarized

- A good presentation was made for the sub-program on hydrogen production and delivery. Very informative and well organized.
- Pat did a good job of reviewing the DOE Production Program-Goals, Projects and tie in to Overall DOE strategies.

Were important problem/issue areas and challenges identified/discussed, including plans for addressing these items in the future?

- The problem/issue areas were adequately discussed.
- As a consultant to the Renewable Fuels Association recognize I am highly biased toward ethanol as a renewable fuel. The plan for addressing the conversion of ethanol to hydrogen was fuzzy and unclear. There seems to be no place in DOE for ethanol. There were presentations on Coal to hydrogen, nuclear to hydrogen, natural gas to hydrogen. There are, properly, advocates for each within DOE. An advocate for ethanol is badly needed.

Does the Subprogram area appear to be focused, managed well, and effective in addressing the Hydrogen Program R&D needs?

- The hydrogen production subprogram covers a wide range of routes to produce hydrogen from different feedstocks.
- A balanced program was presented.
- The program is focused, and managed very well. The comments above concern what is not being done. What is being done is being done well.

Other comments:

- The hydrogen delivery program covers applications for both central and distributed hydrogen production. Both coal to hydrogen and nuclear hydrogen programs are aimed for central hydrogen production. The inputs (comments and suggestions) from coal and nuclear energy offices to the hydrogen delivery program were not adequately discussed.
- In the case of hydrogen production from natural gas, the price of hydrogen is sensitive to natural gas price cost. Will it be more meaningful to say CLEARLY the natural gas price behind the hydrogen target cost?
- Selection of Delivery and Production projects need to be integrated. A difficult hydrogen production technology where the hydrogen delivery to the "forecourt" is inexpensive and readily accomplished is a good project. So is a project where the production of hydrogen is straightforward but delivery is difficult. However coupling a challenging/difficult production technology with a difficult/challenging delivery system should almost always be avoided. Requiring two low probability/high risk projects to be successful to achieve a successful outcome is almost always a loser. If DOE eliminated these low probability/high risk coupled projects, more funds could be applied to projects able to contribute to meeting overall objectives.

Project # SA: Hydrogen Codes and Standards*Antonio Ruiz***Degree to which the Subprogram area was adequately covered and/or summarized**

- Program was very well summarized and made a good introduction to the presentations to be made.

Were important problem/issue areas and challenges identified/discussed, including plans for addressing these items in the future?

- The biggest challenge is harmonization of domestic and international standards. This and the other challenges are recognized and being addressed.

Does the Subprogram area appear to be focused, managed well, and effective in addressing the Hydrogen Program R&D needs?

- Well focused on maintaining safety now by applying best practices and developing standards for the future to assure affordable safety.

Other comments:

- One slide showing the relationship of each of the projects would have been helpful.

Project # ST: Hydrogen Storage

Sunita Satyapal

Degree to which the Subprogram area was adequately covered and/or summarized

- The hydrogen storage program was well covered considering the extent of the program and the large numbers of projects being worked on. The opening presentation provided an excellent overview of the storage program for the group and to set the stage for the more detailed review of R&D in storage. The presentation summarized the high level strategy, reported some interim results and provided a plan (timeline, goals and future research solicitations) to continue R&D to move closer to the goals. DOE did a good job of ensuring that key technical areas were covered either in presentations or posters.
- Very good.
- The overview was complete and accurate with chief achievement description.
- The program was covered very well. Adequate amount of detail was provided.
- All the major areas were specifically covered, analysis programs were covered, plus a nice overview of the whole program, its goals and methods of meeting the goals and the challenges plus the plan to meet them. This criterion was well met.
- Reasonably well.
- Targets were defined in detail.
- Centers of Excellence (CoEs) were detailed in composition and general duties (see No. 4).
- Contacts listed and "open door" policy suggested.
- A very clear, comprehensive, down-to-the point summary of the sub-program, of its strategy and technical goals, recent achievements and work plans. Presentation very well delivered - excellent job!
- I was in attendance from presentation ST-05 through ST-28, so, my comments here and below are based on observations made in the framework of these progress reports. I cannot comment on the subprogram presentation because I was not able to be present, hence, I will focus on my general impression based on the presentations I did attend, with emphasis on the ones I reviewed: The broad spectrum of on going activity in this program area was very well covered. Having the three major storage Centers of Excellence give hour-long overviews was a good idea and should be continued. As is usually the case, the quality of the presentations varied considerably. Some projects did not (or so it seems) put their best foot forward.
- The hydrogen storage area was sufficiently covered. All the new aspects were clearly presented and summarized.
- The presentation was clear. The sub-program area was adequately covered given the time frame of the presentation. A comprehensive snapshot of the state of the storage program was also presented and accomplishments were highlighted.

Were important problem/issue areas and challenges identified/discussed, including plans for addressing these items in the future?

- Yes. The three major goals were covered, and the important issue of system vs. material performance was highlighted. The nature of the challenge presented was illustrated in several ways. Challenges in all of the individual approaches were also pointed out. Approaches to solve the problems were touched on. This criterion was met.
- Yes.
- The challenge is "grand" and was well stated in terms of difficulty and importance.
- Longer-term plans were covered, including go/no go decision points. Upcoming solicitations were described.
- Main accomplishments were identified and discussed along with the persisting problem areas. Attention was drawn to research gaps and challenges in order to guide future R&D activities. Emphasis was paid on short- and long-term plans, milestones and go/no go decisions.

- Most presenters put forth future plans that were consistent with findings/issues emanating from work to date. In some cases, the proposed FY 2007 and FY 2008 tasks were not fully elaborated on or clarified to the point where one could appreciate the future plans. Future planning should be driven by two considerations (1) what is learned from the accumulated knowledge based on work to date and (2) what careful analysis says about the most promising pathways to meeting targets.
- Yes. The lead-in presentation set the stage for – and subsequent presentations provided ample opportunity for the important topics and subject matter areas to be discussed. The allocation for a full hour for presentations by each of the CoEs was a good idea considering the importance of the three centers to the delivery of a viable storage system.
- All the important problems were focused and discussed. In addition challenges and targets were evaluated and set for the future.
- Onboard storage is critical and remains a big challenge. The + and – of the different families of storage materials were outlined and directions discussed. Established a robust portfolio of R&D projects emphasizing HSA [high surface area] materials, and hydrides- complex and chemical.
- The major technical issues have been identified and presented for an open discussion and updating.
- Surface sciences and chemical and material problems were identified and discussed well. But engineering problems, including heat management, impurity in hydrogen, system integration and reactors design were very “slowly” identified and discussed in projects.
- Yes. The barriers were clearly addressed. The work of CoEs and the individual projects were discussed in sufficient detail.

Does the Subprogram area appear to be focused, managed well, and effective in addressing the Hydrogen Program R&D needs?

- The strategy is appropriate, to continue emphasizing a wide net of higher risk - high reward research. The use of the CoEs is an appropriate method to manage this diverse portfolio and promote synergy and enhance innovation. Maintaining independent programs ensures agility. Significant progress has been made already, illustration of the effectiveness of the chosen research. Budget increase in this highly difficult and critical area is appropriate. Frankly, funding needs to be expanded even further, the budget shown represents every American contributing an average of a dime per year; surely the richest nation on earth can do better. Given the budget, the DOE team has met this criterion with excellence.
- The storage subprogram is getting very large. It must be an increasing challenge to the DOE staff to manage the details (progress understanding, duplication, technical judgments, etc.).
- A reasonable balance (not perfect) between program needs and people needs (e.g., questionable or burdensome paperwork).
- This appears to be a very well organized and structured sub-program, efficiently managed and sharply focused on addressing the DOE Hydrogen R&D needs.
- The Hydrogen Storage sub-program is clearly well managed at the DOE TDM [technology development manager] level. The implementation effectiveness is also impressive, considering that earmarking has greatly hampered both the CoE funding and the coordination of all R&D efforts to minimize unnecessary overlap.
- Yes. DOE has done a good job of allocating funds for storage work and ensuring that in recent years research dollars for storage have been protected. The concept of CoEs supplemented by independent research in "stretchy" areas of research seems to be focusing key research entities toward a common goal, and we are starting to see remarkable progress.
- The subprogram is well focused in the most important directions of solving the hydrogen storage problem. The management is exceptional for European standards.
- The storage sub-program is focused on the DOE targets, and seems well managed. It is getting more refined, and constantly evolving in the right direction.
- The sub-program is central in the DOE Program.
- The focus is on key scientific aspects.
- There is a need for slightly increasing the technological and operability aspects in the funded activities.
- The projects and CoEs are well organized. The subprogram has done an excellent job coordinating the efforts and maintaining an effective communication with and within CoEs.
- Yes.

- Subprogram people know the participants very well personally.
- Yes, but DOE targets should be extended and include: minimal [minimum] scale [of examples], maximum temperature, flow rates of hydrogen, impurities limitation and other important [points] for engineering.

Other comments:

- Storage requires breakthrough discoveries. The subprogram activities in the past two years have done an outstanding job in developing the proper background and foundation for achieving these discoveries. The creation and development of the CoEs is proving very effective. All the DOE-EERE people involved with these efforts should be congratulated for their contributions.
- The increasing funding is appropriate, though in fact the DOE does need to have an increasing PEER SELECTED portfolio, which can only be achieved if congressionally directed programs bring their own funding rather than diminish the funds available for expert selected programs. One area that needs more emphasis is tank systems and the materials that are required. Most people feel initial mobile and many stationary systems will use compressed tanks, but these are still too expensive and there is room for research to improve this situation on the material and engineering levels. This will be important as well in future [for] solid-phase materials, which will also use pressure tanks of up to 100 bar to enable refueling in 5 minutes.
- I would like to have heard more about how the CoEs are working:
 - How often do they meet? Telecons?
 - Is there good openness (especially by companies)?
 - Are good collaborations happening?
 - Are there frictions over boundaries?
 - Are there many duplications of effort?
 - Anything of a potential concern to their continuation?
 - Should they be larger? Smaller?
- This is indeed a very strong and well-focused Team Leader with a real vision.
- Recommendations:
 - Keep reminding PIs of system rather than material targets and of the need to address engineering aspects and all critical issues and not just gravimetric capacities.
 - Follow closely the progress of the CoEs; their effectiveness also depends on their coordination which still remains challenging due to their size and scientific diversity.
 - Consider interaction mechanisms among the three CoEs: there are commonalities in some problems and expertise in Centers that could be shared for tackling them. See for instance, off-board regeneration issues arising in projects in the Metal Hydride CoE that could benefit from interactions with the Chemical Hydrogen Storage CoE.
- Here I offer the following suggestion. Clearly, all the hydrogen storage CoEs are struggling to approach 2010 "system" targets for gravimetric and volumetric capacity. The 2015 targets seem out of reach for at least two of the CoEs. It's possible that this will cause discouragement over the progress of these centers towards the current targets in future years. Targets for 2015 that are based on a smaller, lighter, shorter mileage vehicle would be on the edge of commercial reality but still be in the radar range of the three CoEs.
- The UNLV congressionally mandated program has a large sum of money in it and is not very well planned out or well connected with the rest of the HFCIT Program. Next year their "feet should be held to the fire". They should be expected to show significant progress towards resolution of barriers to [and] progress in the hydrogen storage and fuel cell sub-programs. They should also show responsiveness to the comments of this year's review panel. EERE is not in the same business as the Office of Science. The UNLV program looks like an Office of Science enterprise.
- If we are going to finish it's more preferable to take a "big fish-hook"; because it's more pleasant not to "hunt a big fish", than a small one- the same for sciences. Best rewards.

- The storage sessions were very well run. Having sat in several sessions throughout the week, it seemed that the storage session was the only one that rigorously allowed the reviewers to ask questions before opening the Q&A session to the floor. As a result the questions were well-thought out and helped to elucidate the information being presented. Presentations were kept on schedule and agenda moved along smoothly.
- The hydrogen storage subprogram of the DOE is very well organized and always it is mentioned as an example from European scientists.
- In addition to the technical and cost goals for storage materials, the subprogram maybe could/should also address the hazard and safety aspects of the investigated materials. This is a key issue for fuel systems.

Project # TV: Technology Validation

Sig Gronich

Degree to which the Subprogram area was adequately covered and/or summarized

- Adequate.
- Good summary of program, with clear objectives and path forward.
- Presentation summarized program well, and gave a good overview of the impressive progress that has occurred in the last year.
- Program area was very adequately defined. Specific project/programs were identified and summarized.

Were important problem/issue areas and challenges identified/discussed, including plans for addressing these items in the future?

- The challenges were not delineated.
- Problem areas were addressed, and program is structured to provide necessary information for resolution.
- Yes, Programmatic level events and future "coming attractions" were covered.
- Issues such as vehicle range, durability and costs were noted. Program issues such as how to handle proprietary data as well as the volume of data were identified.

Does the Subprogram area appear to be focused, managed well, and effective in addressing the Hydrogen Program R&D needs?

- Adequate.
- Very well-managed program with clear ties to technical targets.
- Yes. Hydrogen infrastructure and FCV's are beginning to enter "the valley of public opinion" when the public decides to get behind this effort and help...or not. The Tech Val programs are the first real public exposure to much of this technology and the careful planning that went into deployment is beginning to show. For instance, there have been no safety incidents of note at any of the sites.
- The program focuses on important issues such as capital costs, durability and efficiencies but it is so broad that some details get lost. It appears to be managed well and good results are being identified but it is still very early.

Other comments:

- This program is a success so far. Maintaining that high performance factor will be challenged by events as they evolve. Flexibility and wisdom in changing the program concurrently will be important. For instance (and not to make a singular fuss over only one thing) it is clear that Honda has a very good, perhaps superior FCV on the road, but this is not included in the present set of DOE Tech Val programs. This may not be important to the validity of DOE's program, but programmatically issues like that and others as they arise need to be fed into the program plan to see if the Technology Validation program should change in some way to accommodate the evolved issue(s).
- Most of the data so far are on small scale demonstrations. They should be scaled up in size to establish the validity of the modeling and results toward the DOE goals.