6. Materials Technologies

Advanced materials are essential for boosting the fuel economy (FE) of modern automobiles while maintaining safety and performance.

Because it takes less energy to accelerate a lighter object than a heavier one, lightweight materials offer great potential for increasing vehicle efficiency. Replacing cast iron and traditional steel components with lightweight materials such as high-strength steel, magnesium (Mg) alloys, aluminum (Al) alloys, carbon fiber (CF), and polymer composites can directly reduce the weight of a vehicle's body and chassis by up to 50% and therefore reduce a vehicle's fuel consumption. A 10% reduction in vehicle weight can result in a 6%-8% FE improvement.

By using lightweight structural materials, cars can carry additional advanced emission control systems, safety devices, and integrated electronic systems without increasing the overall weight of the vehicle. While any vehicle can use lightweight materials, they are especially important for hybrid electric, plug-in hybrid electric, and electric vehicles (EVs). Using lightweight materials in these vehicles can offset the weight of power systems such as batteries and electric motors, improving the efficiency and increasing their all-electric range. Alternatively, the use of lightweight materials could result in needing a smaller and lower cost battery while keeping the all-electric range of plug-in vehicles constant.

Using lightweight components and high-efficiency engines enabled by advanced materials in one quarter of the U.S. fleet could save more than 5 billion gallons of fuel annually by 2030.

The Vehicle Technologies Office (VTO) collaborates with industry to improve materials that will increase vehicle efficiency while meeting consumer and industry expectations. It does this through multiple approaches, including working to lower the cost and improve the properties of lightweight materials while maintaining safety, comfort, reliability, performance, recyclability, and cost.

The major research and development (R&D) goal for Lightweight Materials is:

- By 2015, validate the ability to reduce the weight of a passenger vehicle body and chassis system by 50% compared to a 2002 vehicle. This reduction needs to be cost-effective and the materials need to be recyclable as well.

Subprogram Feedback

The U.S. Department of Energy (DOE) welcomed optional feedback on the overall technical subprogram areas presented during the 2013 Annual Merit Review (AMR). Each subprogram technical session was introduced with a presentation that provided an overview of subprogram goals and recent progress, followed by a series of detailed topic area project presentations.

The reviewers for a given subprogram area who volunteered to provide subprogram overview comments responded to a series of specific questions regarding the breadth, depth, and appropriateness of that DOE VTO subprogram's activities. The subprogram overview questions are listed below, and it should be noted that no scoring metrics were applied. These questions were used for all VTO subprogram overviews.

Question 1: Was the subprogram area adequately covered? Were important issues and challenges identified? Was progress clearly presented in comparison to the previous year?

Question 2: Are plans identified for addressing issues and challenges? Are there gaps in the project portfolio?

Question 3: Does the subprogram area appear to be focused, well-managed, and effective in addressing the DOE Vehicle Technologies Office's needs?

Question 4: Other Comments.

Responses to the subprogram overview questions are summarized in the following pages. Individual reviewer comments for each question are identified under the heading Reviewer 1, Reviewer 2, etc. Note that reviewer comments may be ordered differently; for example, for each specific subprogram overview presentation, the reviewer identified as Reviewer 1 in the first question may not be Reviewer 1 in the second question, etc., as reviewer responses were optional.

Subprogram Overview Comments: William Joost (U.S. Department of Energy) – lm000

Question 1: Was the sub-program area adequately covered? Were important issues and challenges identified? Was progress clearly presented in comparison to the previous year?

Reviewer 1:
The reviewer recounted that last year had also been good. The topic, objectives, and roadmap were exceptionally well understood, and this was communicated very effectively.

Reviewer 2:
The reviewer voiced that the sub-program was adequately covered. The depth and breadth of the program was explained.

Reviewer 3:
The reviewer stated that the sub-program was well focused on many materials. The projects provided inputs to policymakers and regulators as well regarding various aspects of lightweighting, such as lifecycle assessment, accidents, and cost models. The portfolio of projects was quite diverse. This reviewer noted that, as many of the past projects were coming to an end, the share of Mg was slowly reducing. With the opening of the CF manufacturing center, more projects on this area might be expected. However, this reviewer added that the portfolio should not drop the long-term focus and support some fundamental studies on material development.

Reviewer 4:
The reviewer remarked that the sub-program covered the big four structural materials being considered for lightweight applications (steel, MG, Al, and CF composites). However, this reviewer added that CF composites were only a subset of the category of composites. The focus on low-cost CF composites should continue to be an area of research; however, additional combinations of composite materials should be and were being considered for research and application development. These composite solutions included mineral, glass, carbon, etc., and spanned the spectrum of aspect ratios (short, long, and continuous). Composites also included plastic-metal-hybrid structures (steel, Al), hence the focus on the joining of dissimilar materials. Multi-material solutions became even more key to lightweighting, not just in the multi-material vehicle (with individual components constructed of different materials), but as multiple materials being processed into individual applications.

Question 2: Are plans identified for addressing issues and challenges? Are there gaps in the project portfolio?

Reviewer 1:
The reviewer pointed out that issues and challenges of the four categories of structural materials have been identified, adding that multi-material solutions were becoming more critical to developing lightweight vehicles. This reviewer further noted that categorizing research by material type precluded the idea of the multi-material solution, and suggested that perhaps a new category should be considered.

Reviewer 2:
The reviewer observed that the plan was in place to achieve the objectives. The reviewer added that a gap existed that was not discussed, which was the issue of specifically what would happen if low-cost CF was not successfully developed. A significant level of accomplishment had been realized in the area of Mg cast and wrought product.

Reviewer 3:
The reviewer said that the plans were clear as far as the past solicitations could allow. This person added that the future plans were a bit weak in details.

Reviewer 4:
The reviewer mentioned that, as the department moved toward more solicitations, it might be difficult to focus on fundamental issues. This reviewer added that there should be some allocation of funds for the basic sciences on materials for automotive structures. Also, it should be determined whether the materials currently in use were suitable for additive manufacturing processes.

Question 3: Does the sub-program area appear to be focused, well-managed, and effective in addressing the DOE Vehicle Technologies Program's needs?

Reviewer 1:
The reviewer said that yes, it was a very focused effort that was well planned and executed.

Reviewer 2:
The reviewer affirmed that it was very well managed.

Reviewer 3:
The reviewer said it was focused.

Question 4: Other Comments

Reviewer 1:
The reviewer stated that overall, as a tax-paying technology person, the monies spent were well directed and managed toward a focused goal. This reviewer applauded the good job.

Reviewer 2:
The reviewer indicated a very good lead into the sub-program roadmaps.

Reviewer 3:
The reviewer specified it was a presentation on the evolution of technologies as funded by this program from the past to the present (i.e., what technologies/materials had been funded in the past, and how the success/failure of those projects drove the current developments).

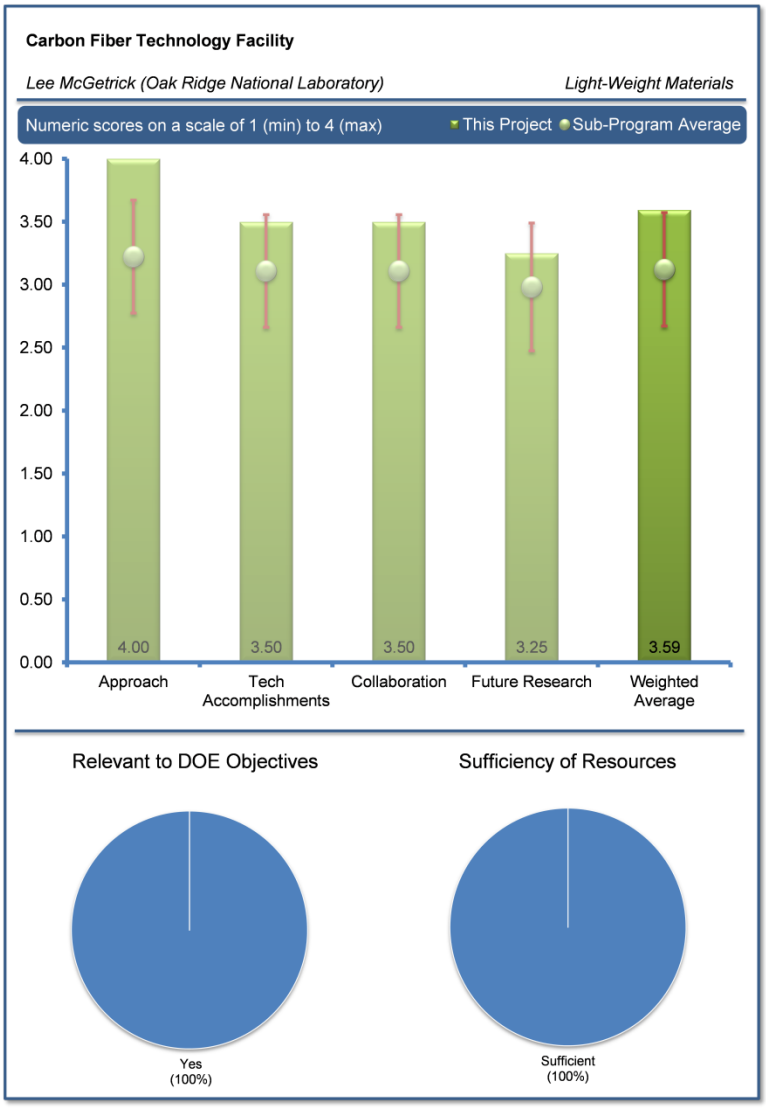
Project Feedback

In this merit review activity, each reviewer was asked to respond to a series of questions, involving multiple-choice responses, expository responses where text comments were requested, as well as numeric scoring responses *(on a scale of 1 to 4)*. In the pages that follow, the reviewer responses to each question for each project will be summarized: the multiple choice and numeric score questions will be presented in graph form for each project, and the expository text responses will be summarized in paragraph form for each question. A summary table presenting the average numeric score for each question for each project is presented below.

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Carbon Fiber Technology Facility	Lee McGetrick (Oak Ridge National Laboratory)	6-6	4.00	3.50	3.50	3.25	3.59
Advanced Oxidation & Stabilization of PAN-Based Carbon Precursor Fibers	Dave Warren (Oak Ridge National Laboratory)	6-9	3.75	3.00	3.00	3.50	3.25
Scale-Up of Magnesium Production by Fully Stabilized Zirconia Electrolysis	Steve Derezinski (MOxST)	6-11	3.40	3.20	3.20	3.20	3.25
Low Cost Carbon Fiber Composites for Lightweight Vehicle Parts	Jim Stike (Materials Innovation Tech)	6-14	3.75	3.75	3.75	3.00	3.66
Development and Commercialization of a Novel Low-Cost Carbon Fiber	George Husman (Zoltek)	6-17	3.00	2.75	2.75	2.00	2.72
On-Line Weld NDE with IR Thermography	Dave Warren (Oak Ridge National Laboratory)	6-19	3.50	3.00	3.00	2.75	3.09
Non-Rare Earth High-Performance Wrought Magnesium Alloys	Curt Lavender (Pacific Northwest National Laboratory)	6-22	3.00	3.00	3.00	3.00	3.00
PNNL: Mechanistic-Based Ductility Prediction for Complex Mg Castings	Xin Sun (Pacific Northwest National Laboratory)	6-25	3.00	3.00	3.00	3.00	3.00
Low-Cost Magnesium Sheet Production using the Twin Roll Casting Process and Asymmetric Rolling	Murali Muralidharan (Oak Ridge National Laboratory)	6-27	3.00	2.75	2.75	2.75	2.81
Aerodynamic Lightweight Cab Structure Components	Mark Smith (Pacific Northwest National Laboratory)	6-29	3.80	3.60	3.60	3.40	3.63
Improving Fatigue Performance of AHSS Welds	Dave Warren (Oak Ridge National Laboratory)	6-32	2.67	3.67	3.67	3.00	3.33
Microwave Assisted Plasma Processing of Carbon Fiber	Felix Paulauskas (Oak Ridge National Laboratory)	6-35	3.00	3.00	3.00	3.50	3.06
Vehicle Mass Impact on Vehicle Losses and Fuel Economy	Barney Carlson (Idaho National Laboratory)	6-37	3.50	3.25	3.25	2.75	3.25
Analysis of Casualty Risks by Vehicle Type and Make	Tom Wenzel (Lawrence Berkeley National Laboratory)	6-39	3.00	3.00	3.00	2.75	2.97
Multi-Material Lightweight Prototype Vehicle	Tim Skszek (VEHMA)	6-42	3.25	3.50	3.50	3.75	3.47
IR Heat Treatment of Hybrid Steel-Al Joints	Thomas Watkins (Oak Ridge National Laboratory)	6-45	2.50	3.25	3.25	2.00	2.91
SPR Process Simulation, Analyses, & Development for Mg Joints	Elizabeth Stephens (Pacific Northwest National Laboratory)	6-48	2.20	1.60	1.60	1.60	1.75
High Speed Joining of Dissimilar Al Alloy TWBs	Yuri Hovanski (Pacific Northwest National Laboratory)	6-52	4.00	3.80	3.80	3.80	3.85
Understanding Protective Film Formation by Magnesium Alloys	Kinga Unocic (Oak Ridge National	6-55	3.20	2.80	2.80	2.80	2.90

in Automotive Applications	Laboratory)						
Mg Intensive Vehicle Front End Sub-structure	Alan Luo (USAMP)	6-58	3.25	3.50	3.50	3.25	3.41
Aluminum Formability Extension through Superior Blank Processing	Xin Sun (Pacific Northwest National Laboratory)	6-61	3.40	3.00	3.00	3.20	3.13
Enhanced Room-Temperature Formability in High-Strength Aluminum Alloys through Pulse-Pressure Forming	Rich Davies (Pacific Northwest National Laboratory)	6-64	3.00	3.00	3.00	3.00	3.00
ICME Development of 3rd Gen Advanced High Strength Steels	Lou Hector (USAMP)	6-67	3.00	2.75	2.75	3.00	2.84
GATE Lightweight Materials Center	Uday Vaidya (The University of Alabama at Birmingham)	6-70	3.67	3.33	3.33	3.33	3.42
Microstructure and Deformation Fundamentals in Advanced High Strength Steels	Xin Sun (Pacific Northwest National Laboratory)	6-72	2.75	2.75	2.75	3.00	2.78
Overall Average			3.22	3.11	3.11	2.98	3.12

Carbon Fiber Technology Facility: Lee McGetrick (Oak Ridge National Laboratory) - lm003



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

The reviewer stated that this project is an excellent example of an idea brought to reality with industry and government involvement. Also, the reviewer noted that the Carbon Fiber Technology Facility (CFTF) is a great national asset to the U.S. technology base and should be showcased.

Reviewer 2:

The reviewer stated that the approach was a good capital investment for future research.

Reviewer 3:

The reviewer stated the CFTF was the best investment in which DOE and the Oak Ridge National Laboratory (ORNL) could have invested. In addition, the reviewer observed that scaling the lab process to a make-like-production facility to produce low-cost carbon fibers (LCCF) is just starting the process. The reviewer expressed interest in seeing three of these systems, like the one at ORNL, replicated in industry to supply the LCCF.

Reviewer 4:

This reviewer remarked that the key milestone of the project was achieved on March 26, 2013. This reviewer observed that the Environmental Health and Safety (EH&S) requirements of the facilities appeared to have been well thought through. The reviewer also noted that training requirements for the employees were addressed and a good training curriculum was put in place.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

The reviewer noted excellent work that was ahead of schedule and under budget.

Reviewer 2:

The reviewer observed good progress in getting the equipment ready ahead of schedule.

Reviewer 3:
This reviewer stated that establishing a running facility was a major success.

Reviewer 4:
This reviewer said that although there were start-up issues, significant progress was made getting an industry first system up and running.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer stated that the researcher had a good list of partners for executing the construction of the facility. The reviewer observed that the researcher also had an excellent list of potential partners for future clients of the center.

Reviewer 2:
The reviewer said that the researcher had a very solid comprehensive list of collaborators, and partnerships with key outside organizations were established.

Reviewer 3:
The reviewer stated the ORNL facility has done an excellent job reaching out and offering CF product for testing.

Reviewer 4:
The reviewer observed that the doors are open for collaboration.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
The reviewer said that this project is a national asset and one of the best investments. The reviewer also stated that the investigator should continue to focus on the next R&D body of work required to replicate this project, and develop the knowledge to scale this project to a full production operation.

Reviewer 2:
This reviewer noted that for composites to grow and compete against other technologies, it becomes key to educate current and future engineers on the capabilities of CF composite. The reviewer also noted this national asset could play a part in this type of education. This goes beyond the workforce training outlined in the presentation.

Reviewer 3:
The reviewer stated there were lots of ideas to be tested.

Reviewer 4:
This reviewer noticed that technology scaling was addressed, and there seemed to be sufficient levels of industry partnerships. However, the reviewer observed there could be more emphasis on reviewing the impact of the scaled-up facility on the overall cost picture of CF composite.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that having a center of excellence like this can help the technical community focus on the science of LCCF, and research projects, like microwave-assisted or plasma-assisted oxidation.

Reviewer 2:

This reviewer stated that lab scale R&D to large scale-up is very important aspect of the overall DOE objective. This reviewer also noted the capabilities within the facilities are certainly a key enabler.

Reviewer 3:

This reviewer stated that CF delivers the future weight savings needed in the automotive industry. Further, the reviewer said to press on with the progress, as it is 110% relevant.

Reviewer 4:

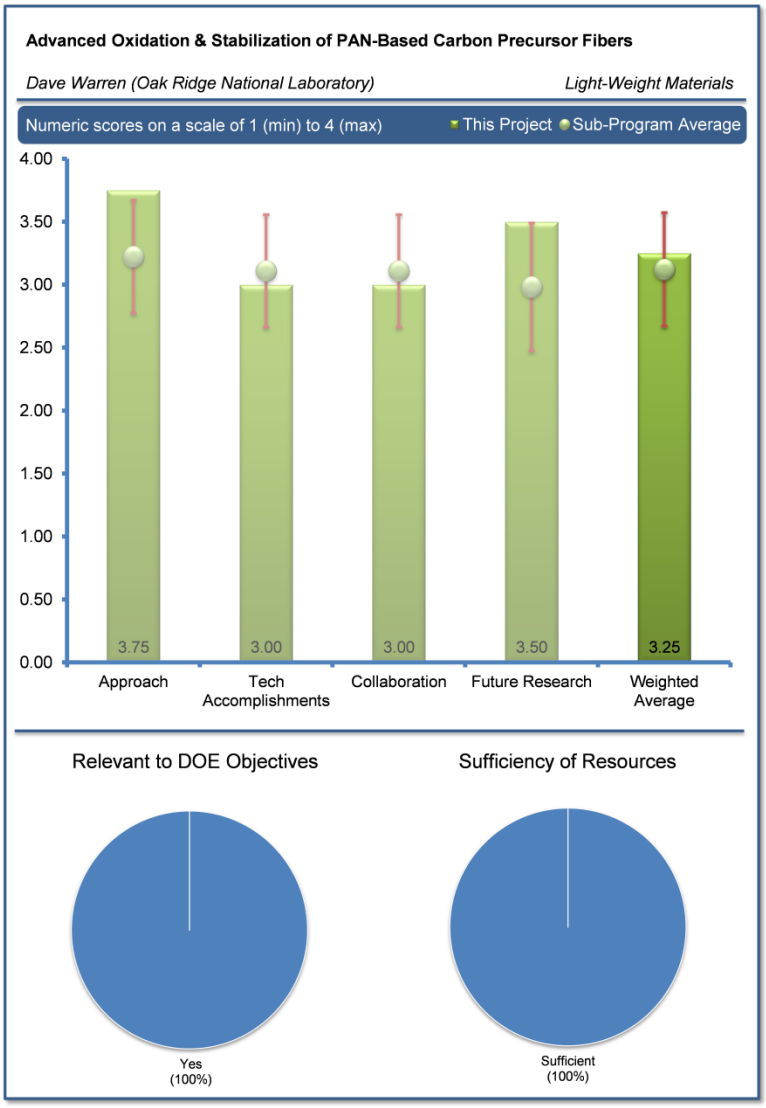
The reviewer stated the project enables the final validation of the project products from other activities.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:

The reviewer stated this project was a well-spent $35 million of taxpayer dollars.

Advanced Oxidation & Stabilization of PAN-Based Carbon Precursor Fibers: Dave Warren (Oak Ridge National Laboratory) - lm006



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer stated that the outline of the approach is very well documented and explained. The reviewer also noted that, as outlined in the presentation, this work addresses one element of the major cost elements of CF costs.

Reviewer 2:

This reviewer said it is understood that this project is export controlled and not too much data could be presented, but that regardless, there was excellent progress. This reviewer also observed plasma oxidation is a major potential enabler to a universal sizing of the tow, hopefully eliminating the need for specific sizing and using tailored resins.

Reviewer 3:

This reviewer stated the project reduces the oxidation time extensively.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer stated technical accomplishments appear on track with improvements in strength and modulus, and good surface of the fibers. The reviewer noted the modulus is a bit low, but improving. In addition, the reviewer said some concern was expressed during the review with respect to the spread of the data (specifically modulus after carbonization), but would be expected during scale-up. The reviewer also observed process consistency will be critical when final production scale materials are ready.

Reviewer 2:

This reviewer stated residence time needs to be shortened for large tows.

Reviewer 3:

This reviewer said progress is slow, but measurable and in the right direction. The reviewer observed there was not enough discussion on the cost for plasma oxidation, which should be focused on during the next review in 2014.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer stated despite export control, the project still managed to have acceptable collaboration.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
The reviewer said this technology shows promise. The reviewer looks forward to seeing the end result.

Reviewer 2:
The reviewer observed this project is an excellent R&D process and that the project looks like a promising new technique for processing CF.

Reviewer 3:
This reviewer reported 3 tows or more of 20,000 in less than 30 minutes.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer feels this technology is right on track with developing a LCCF material that can be used for lightweight, structural, and automotive applications.

Reviewer 2:
This reviewer said this project nicely supplements the CF programs at ORNL.

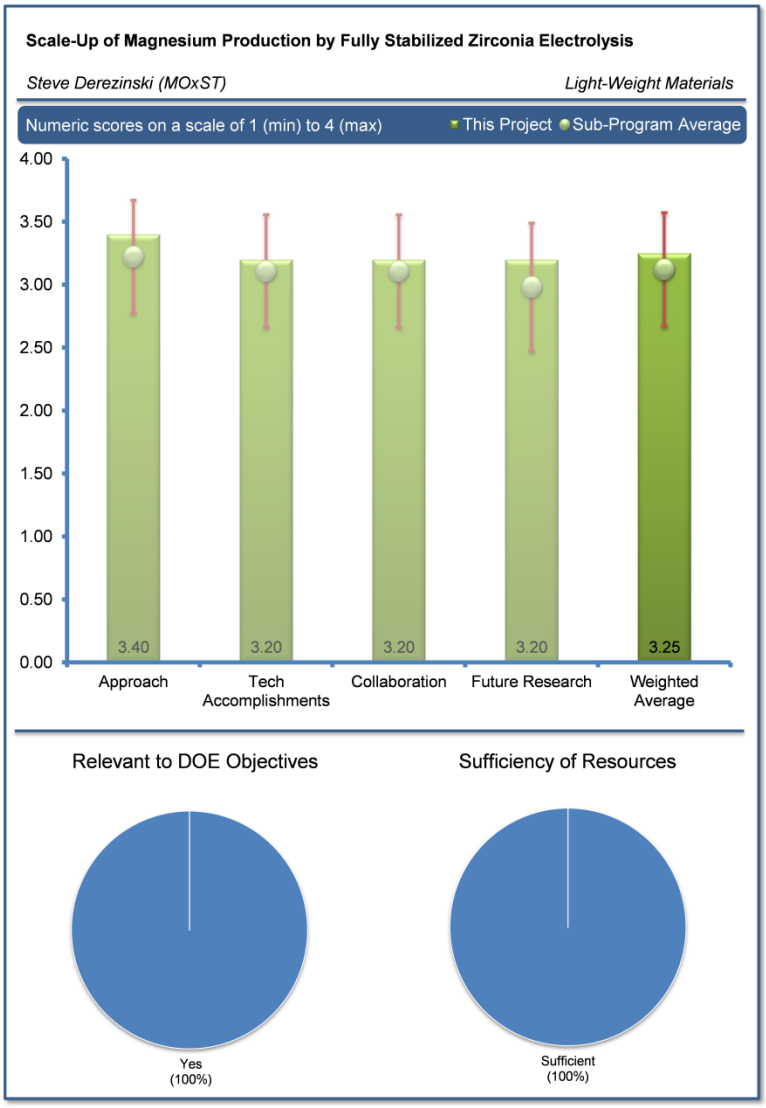
Reviewer 3:
This reviewer commented that the project has the potential to effectively address the oxidative stabilization long processing time.

Reviewer 4:
The reviewer affirmed that the cost of CF is being reduced.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer would not add additional funding, but continue on with current track or R&D.

Scale-Up of Magnesium Production by Fully Stabilized Zirconia Electrolysis: Steve Derezinski (MOxST) - lm035



Reviewer Sample Size

A total of five reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer said excellent work, on track and on schedule.

Reviewer 2:

This reviewer asserted the approach towards commercialization seems effective. The reviewer also noted the technical barriers are identified and being addressed.

Reviewer 3:

This reviewer said it would be a good idea to set up the alpha-unit and run continuously, as doing this should help with predicting and production bottlenecks. This reviewer would like to see how the modeling predicts what is going on in the alpha-unit and how it shaped the production of the beta-unit.

Reviewer 4:

This reviewer affirmed the scaling up is planned well; however, it is to be seen how the larger-scale production will turn out. The reviewer also noted the reliability of the zirconium oxide tubes over larger scale and size is to be proven; however, by using many small electrodes the risk of complete cell failure may be reduced.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer stated there were very good technical accomplishments and progress. The reviewer remarked this activity includes many barriers, some of which will not be observed until production scale.

Reviewer 2:

This reviewer mentioned the development of the electrodes is progressing well. The reviewer also stated the completion of alpha design for the cells is commendable as it is proven for 500-hour operation. The reviewer also mentioned design of the beta cell is in progress. This reviewer remarked the development of a production site should be a business activity and should not be counted as a technical achievement. The reviewer is not sure how this can be taken as a deliverable for the DOE proposal as this is a business decision, not technical.

Reviewer 3:
This reviewer stated it looks like biggest barrier is the anode. The reviewer also voiced a need to address or show how the modeling is helping overcome this barrier.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer noted there was outstanding collaboration with third-party consultant reviewers and employees to overcome barriers.

Reviewer 2:
This reviewer noticed many suppliers are involved in the project, as it is necessary when scaling up is planned in future. Also, the reviewer noted it is good that a primary metal company is being involved as marketing and inventory buildup will require resources.

Reviewer 3:
This reviewer would like to see more early collaboration with equipment manufacturers, especially when dealing with scale-up. In addition, this reviewer would like to see some early collaboration with the User Community where this will be used, how are alloying elements going to be added, etc. The reviewer observed that this was not entirely clear in the presentation.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer stated scaling up is the proposed plan and that it appears that the team is progressing well.

Reviewer 2:
This reviewer noted that there were outstanding plans to commercialize. This reviewer also observed application of oxide reduction processing is being applied to rare earth series. A slight concern of this reviewer is that government funds are being redirected to include multiple material systems. This reviewer also stated the results are promising.

Reviewer 3:
This reviewer would like to know more about the Beta-furnace and how it will be used to overcome technical barriers seen in the alpha-unit. The reviewer also inquired about the type of problems foreseen in the beta-unit based on the modeling and simulation and the alpha-unit.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer emphasized absolutely.

Reviewer 2:
This reviewer stated Mg is a potential replacement for other metal alloys in transportation industries. The reviewer also observed if Mg could replace other materials mass savings would be significant. In addition, the reviewer noted a significant challenge for the present project is the generation of Mg alloys that can be stamped at room temperature without immediate fracture (i.e., activation of non-basal slip systems).

Reviewer 3:
This reviewer stated that a need exists for more domestic supply of low-cost Mg.

Reviewer 4:

This reviewer remarked Mg is the lightest material that can be used to reduce the weight of the vehicle. The reviewer observed that a very limited supply exists in North America, which is also energy-intensive. The reviewer stated the project is researching ways to reduce the energy consumption of the primary Mg production, which can pave the way for more use of this material in vehicles.

Reviewer 5:

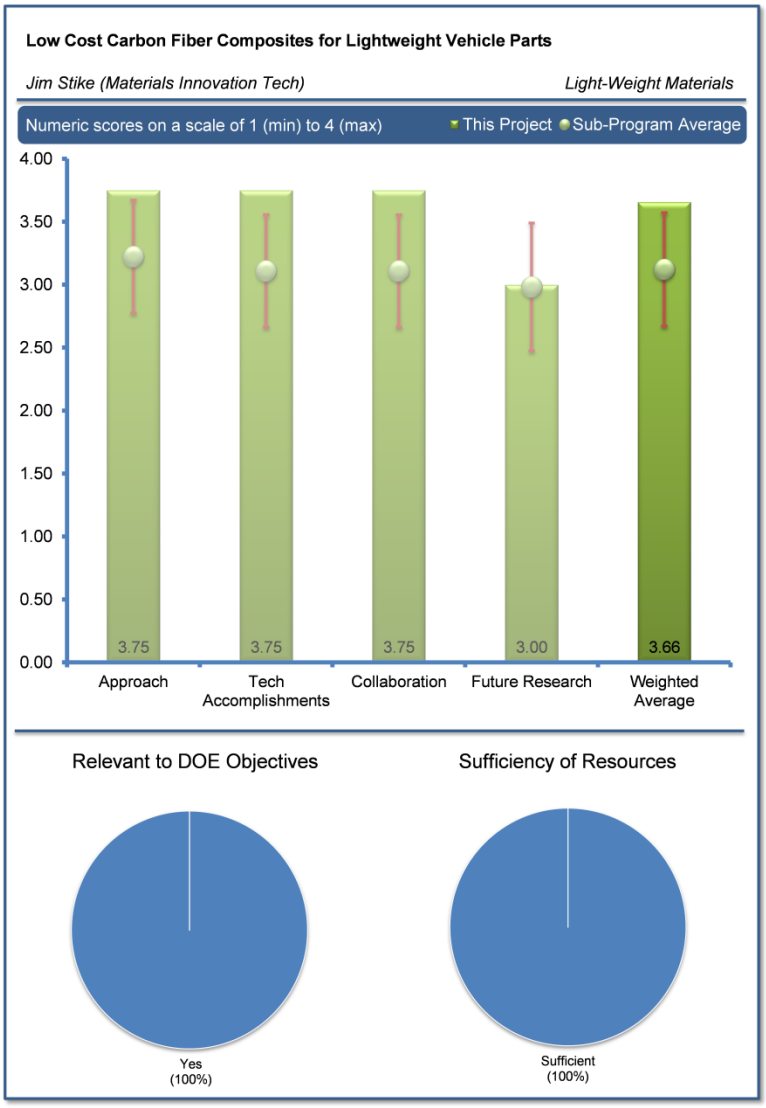
This reviewer observed lower-cost Mg production will help with the transition from steel-centric automotive structure to light alloys, reducing the weight of vehicles. The reviewer remarked this project will indirectly help this goal.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:

This reviewer stated that resources seem appropriate to move beyond demonstration of principle.

Low Cost Carbon Fiber Composites for Lightweight Vehicle Parts: Jim Stike (Materials Innovation Tech) - lm047



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer said a great method for recycling of CF.

Reviewer 2:

This reviewer remarked good demonstration of different types of parts, simple to complex geometries, and that the approach seems to be completely focused on process development. The reviewer also stated reasonable progress has been made in 2013.

Reviewer 3:

This reviewer stated the approach for this work is a good example of the straightforward application of an idea into commercialization. The reviewer noted innovating on the idea of slurry systems, combined with recycled materials, combined with production applications and market need helped drive this project. The reviewer said the approach is solid.

Reviewer 4:

This reviewer said recycling is still important, and must be addressed as a system to deliver CF for transportation applications. The reviewer also remarked that this project is a very important aspect of secondary and tertiary use of CF, a very expensive commodity.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer observed good progress in scaling the process for both the roll and three-dimensional engineered preform (3-DEP) tank processing. The reviewer is very interested in the hybrid systems combining high cost CF with lower cost nanofiber (NF) products.

Reviewer 2:

The reviewer stated components were made with recycled fiber.

Reviewer 3:

The reviewer pointed out that the end results (i.e., prototype automotive and bus parts) were exhibited. The reviewer stated the objective was commercially launched programs; however, the developments to-date show good progress, both with the rolled goods and the 3-DEP process. The reviewer remarked technical data on material properties is lacking. The reviewer stated that the

presentation lists 40% mass savings, which is the high-level objective, but asked what properties were/can be obtained. The reviewer believes strength and stiffness versus thickness data should be shown and compared to traditional (glass, wood, etc.) low basis weight materials.

The reviewer noted that the schematic of the 3-DEP process and the images of the tank and tool do not clearly explain what the actual process is. The reviewer stated that viewing the video made the process self-explanatory, and described it as very impactful. The reviewer suggests better imagery in a stand-alone document.

Reviewer 4:

The reviewer stated that much of technical accomplishments have been presented on fabricating parts for commercial viability. The reviewer remarked that the presented progress lacks review of mechanical, thermal, and dimensional properties. The only reference in the presentation was a discussion on 1% density variance.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer stated that there was an excellent list of reputable tiers and original equipment manufacturers (OEMs).

Reviewer 2:

The reviewer indicated that there were good collaborations with OEMs and composite molders.

Reviewer 3:

This reviewer noticed that there appears to be a cross-collaboration of activities on multiple fronts: customer engagement, procurement of materials, and putting in place capabilities to scale up the operations.

Reviewer 4:

The reviewer stated that the project appeared to have the same collaborators [i.e., Protera, General Motors (GM), Ford, International Automotive Components (IAC), etc.].

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:

This reviewer noted that there was a good list of potential work. Predicting fluid (and fiber) flow in 3-DEP tank using computational fluid dynamics (CFD) will be very challenging.

Reviewer 2:

The reviewer observed that much of the proposed future work is focused around customer buy-in and process scale-up prove out. It would be good if some focus could be given to possible design/material selection guidelines associated with the process. The reviewer added that relative cost comparison would also provide a better understanding of the project merits as well. The reviewer indicated that a review of energy consumption in producing parts with roll goods and 3-DEP process would also be beneficial.

Reviewer 3:

This reviewer noted that future research is focused more on scale, which is acceptable, but not necessarily research. Rather, this is process development.

Reviewer 4:

This reviewer indicated the project needs to look into higher-value parts.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer commented that this project was an excellent connection to upcycling CF.

Reviewer 2:
This reviewer stated that the project definitely focused on achieving lightweight solutions for applications that may not require the full benefits of continuous CF reinforcements. The reviewer added that the project also addressed the unique abilities of the process in using reclaimed CF.

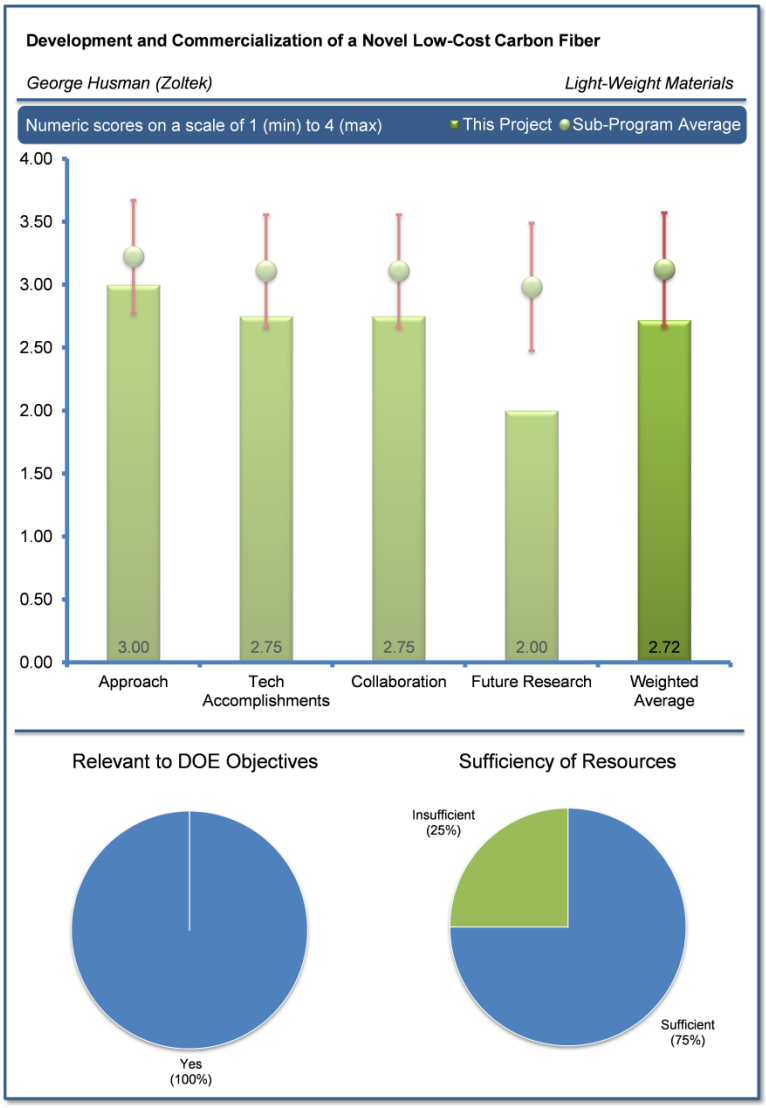
Reviewer 3:
This reviewer said that avoiding landfills encourages the use of CF composites.

Reviewer 4:
The reviewer indicated this technology will help take mass out of applications that are already produced in lightweight materials. The overall impact will be small with respect to other (more structural) technologies; however, it is still in line with the DOE objectives.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
The reviewer stated that this program looks to be well-funded and on track.

Development and Commercialization of a Novel Low-Cost Carbon Fiber: George Husman (Zoltek) - lm048



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

The reviewer stated that the objective and approach on this project are well defined, quantifiable, and measurable.

Reviewer 2:

The reviewer remarked that the approach of mixing lignin with polyacrylonitrile (PAN) is a reasonable route.

Reviewer 3:

The reviewer pointed out that the decision to delay the project for addressing technical issue was the correct decision.

Reviewer 4:

This reviewer indicated that not much progress was made on creating a robust lignin/PAN polymer blend precursor (L/P) that represents a reasonable chance of reducing the cost of CF down to the $5 per pound price range. The reviewer added that the issues with the molecular weight (MW) distribution are a concern and it looks like there is still an unknown as to what ratio should be used (i.e., 35%, 25%, 15%, etc.). The reviewer stated that the project team should continue to work toward a robust process; this project still looks highly experimental as opposed to a precursor for make-like-production.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

The reviewer stated that the technical accomplishments show progress towards the goal.

Reviewer 2:

The reviewer indicated that the mechanical properties of the fibers are not as good as they should be.

Reviewer 3:

This reviewer opined the issues seem to be more of a lack of knowledge of the chemistry than equipment issues. There still seems to be a big unknown in the processing of the final product into CF in Europe.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer suggested that the project team should continue to reach out to end users, automotive, etc., to test and validate performance. But based on the variety of L/P systems sent to Europe, it does not look like a lot of material will be available. The reviewer stated that the U.S. production of the L/P should increase significantly to allow for more available CF from Europe.

Reviewer 2:
This reviewer said that collaboration on addressing technical barriers could have been articulated better.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer opined that the plan forward needs to be addressed now that the unexpected challenge of mixing the morphologies of PAN and lignin has arisen. It was not clearly outlined in the presentation what the steps were to improved MW distribution. The reviewer added that although the specifics may be proprietary, a high-level outline could be provided.

Reviewer 2:
This reviewer stated that oxidation on lignin fundamentals was not referenced. The reviewer indicated that the researcher was not very clear on the level of complexities involved in bringing closure to Phase I deliverables. The reviewer questioned, based on learning to date, if Phase II project details shown on page five are adequate.

Reviewer 3:
This reviewer stated that there does not seem to be a clear path forward to improve mechanical properties.

Reviewer 4:
This reviewer observed that there was really no talk about future research, with the team mostly trying to get the existing L/P chemistry to work.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer pointed out that the development of LCCF supports automotive applications that are lightweight, in turn helping to reduce our dependence on foreign oil.

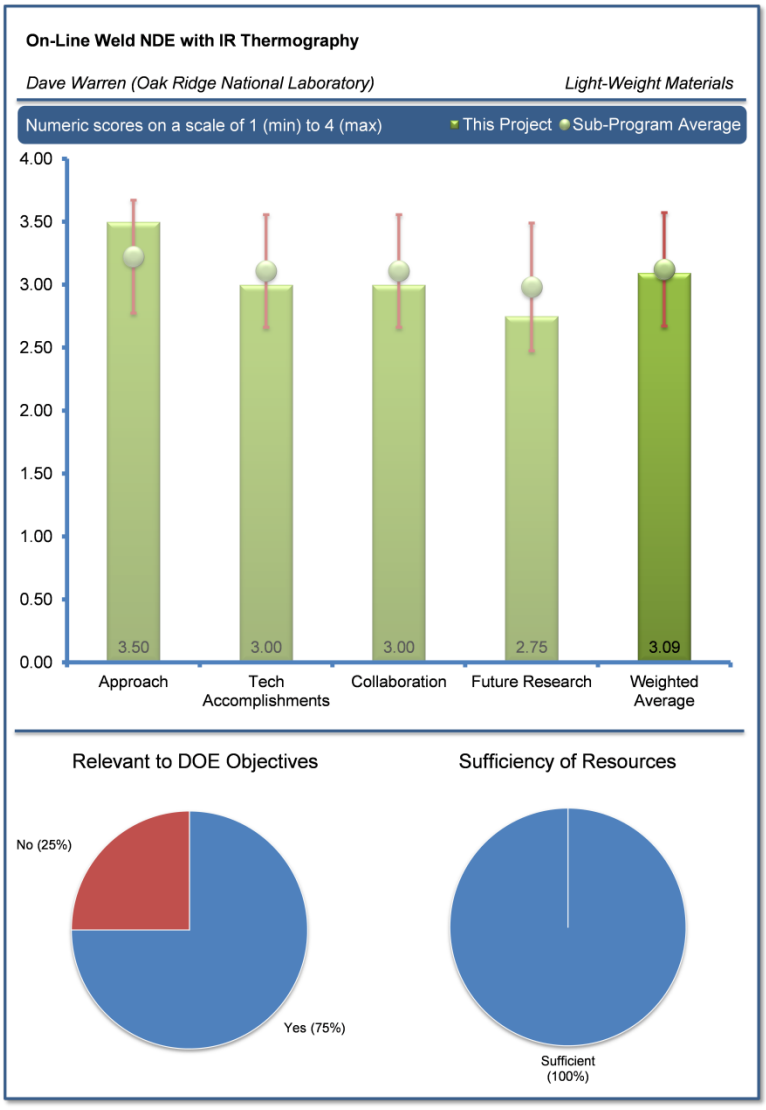
Reviewer 2:
This reviewer said that the low-cost aspect is supported.

Reviewer 3:
This reviewer stated that the project group should continue to focus on $5 per pound; the reviewer heard more like $7 per pound at this stage. For L/P, this is getting too expensive.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer indicated that the funding is appropriate.

On-Line Weld NDE with IR Thermography: Dave Warren (Oak Ridge National Laboratory) - lm054



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer pointed out that the three-pronged approach to this problem is efficiently directed to yield the best results. Additionally, the infrared (IR) post-mortem database of welds with associated quality metrics will serve as a great addition to the industry's knowledge.

Reviewer 2:

This reviewer stated that the approach seems detailed and sound.

Reviewer 3:

This reviewer stated that the project had a good approach but it needs a weld systems supplier (Fronius, Valiant) to integrate technology with the project's weld control.

Reviewer 4:

The reviewer summarized the project by saying the project tested many steel variations including thicknesses and surface conditions. After welding the quality of the weld as well as defects created are detected. Many of the measurements have been compared with IR measurements. The reviewer indicated that the approach is balanced but some correlation with actual mechanical testing of the assessed welds would have been more useful.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer stated that excellent progress has been made towards both the original goals and the expanded goals for more welds of different materials and coatings. Hopefully, further efforts can be initiated on reducing the cost of the inspection system to below the $30,000 point.

Reviewer 2:

The reviewer observed that the database and the user manual for the steel combinations with various thicknesses and surface conditions are an excellent outcome of the project. Technical demonstrations will help make this procedure a more widely used one.

Reviewer 3:

The reviewer stated that good progress was demonstrated in the hardware, software and user interface in the lab setting. The reviewer added that the project team will still have to ensure that the system and methodology will apply in actual plant environment.

Reviewer 4:
This reviewer noticed that there were good accomplishments, and progress is slow due to the lack of a partner.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer observed that the team contains all the right members in automotive, steel, IR equipment and software industries. The reviewer added that there were good efforts, good planning, and good teamwork.

Reviewer 2:
This reviewer said that there appears to be good involvement of auto and steel company representatives.

Reviewer 3:
This reviewer indicated that three North American OEMs and at least one steel supplier are partnering in the project. The database can be used by many producers. The reviewer added that publication and demonstration of the technology will help make this test method more widely used.

Reviewer 4:
This reviewer stated that this is the issue, and the statement says it perfectly.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer stated that the proposed future work to beta test this system in a plant environment is critical. Additionally, the commercialization with a non-destructive evaluation (NDE) partner for widespread use of this technology is also critical.

Reviewer 2:
This reviewer commented that the project is completed in the current Fiscal Year (FY) and no future funding is being requested; however, the presented plans were for conducting work on non-ferrous metals. The reviewer added that the effort should be expanded to multi-material joints as well, if possible.

Reviewer 3:
This reviewer remarked that continuation should be dependent on identifying a commercialization partner.

Reviewer 4:
This reviewer stated that the plans for the current project seem appropriate. Also, plans for additional future work appear to be rather general. The reviewer added that the plans seem to be based on the assumption that joints in the other materials and joining processes will automatically have the same characteristics as did the steel resistance spot welds.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer stated that if successful, this technique could encourage the increased use of higher strength and or lighter materials, and it could also reduce the cost to manufacture vehicles thereby further motivating increased use of those lighter materials.

Reviewer 2:
The reviewer remarked that this project addresses a key potential stumbling block to the further use of advanced high-strength steels (AHSS) in future lightweight vehicle designs. The reviewer commented that the quality of the welding is critical for the performance of lightweight steel structures. Additionally, the cost of current destructive testing can be reduced.

Reviewer 3:

This reviewer observed that spot welding is still the largest joining process used for metals for vehicle production. Also, the quality of these welds needs to be checked periodically, and this project is developing an on-line/offline test method which will improve the reliability. The reviewer added that this project is an enabler, if the database is extended for multi-material joints.

Reviewer 4:

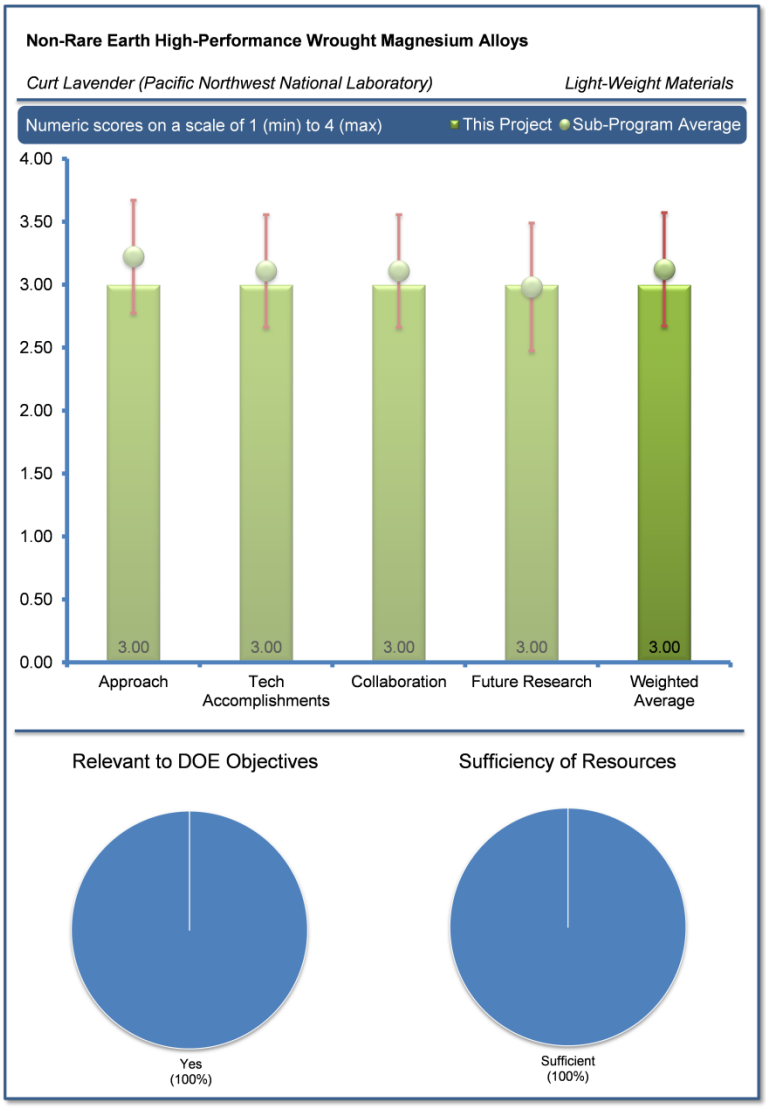
This reviewer stated that this is a quality and reliability issue with little impact on lightweighting technologies

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:

The reviewer pointed out that with the demonstrated accomplishments on the weld database and NDE analysis, the team appears to have sufficient resources for this project.

Non-Rare Earth High-Performance Wrought Magnesium Alloys: Curt Lavender (Pacific Northwest National Laboratory) - lm056



Reviewer Sample Size

A total of five reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

The reviewer stated that the development of wrought Mg alloys for high impact strength is the objective. The reviewer observed the modeling efforts to predict the best material necessary is good approach. The reviewer added that consideration has been given to the corrosion resistance as well as the cost of material; however, the alloy can be expensive if it is not easily processed. Non-conventional alloying additions such as silicon and a new extrusion process can increase the cost significantly; however, if the fundamental mechanisms are understood it is possible to reduce the cost in future.

Reviewer 2:

This reviewer remarked that the project team has had good initial success replacing high cost alloying elements with high cost processing to get Mg alloy up to the objective. In addition, the process to reduce cost can only create limited shapes, but is still appropriate for some commercial parts for weight reduction. The reviewer added that the project team is trying to optimize this selected process through combined modeling, intermetallic elements, and testing, which seems to have a good chance for success, but the final cost is still a question.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer stated that the development of a new manufacturing process, shear extrusion, is a significant development. The reviewer added that the development of microstructure during this process and the loading simulation is good work; however, economic feasibility of the new alloy and the process needs to be proven.

Reviewer 2:

This reviewer indicated that the high shear extrusion process to produce the fine grain tubes at a semi-reasonable rate may reduce the production cost. The performance goals are still being met, but still some work needs to be done. The reviewer added that the project team is trying to optimize this selected process through combined modeling, intermetallic elements, and testing which seems to have a good chance for success, but the final cost is still a question. Also, the reviewer stated that the modeling using viscoplastic self-

consistent (VPSC) adds a seemingly semi-physical parameter that can capture the overall grain effect (but this was not the presenter's technical strength). The inverse modeling seems more physical and might aid the chances of success.

Reviewer 3:
This reviewer commented that there was good progress to make tubes; the reviewer would like to see the results of expanding to a bigger cross section. The reviewer stated that it would be more useful for automotive and defense applications.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer pointed out that the team seems capable in their areas of specialty, but deeper understandings might not be transferred between the team members.

Reviewer 2:
This reviewer stated that the basic work of this project has a good partnership with academic researchers. Involving some of the material suppliers and users is good sense.

Reviewer 3:
This reviewer observed that it is clear that the Georgia Institute of Technology is collaborating in the modeling and simulation, but it is unclear what Magna/Cosma is bringing to the table. The reviewer would like to see collaboration grow, especially in providing guidance with what type of structural components are being targeted.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer looks forward to seeing the scale-up of alloy extrusion.

Reviewer 2:
This reviewer commented that the work plan is more on modeling development and less on experimental work. The reviewer suggested that the team think about a commercial alloy AS21, which has 1% silicon. This will reduce the cost of production. Also, alloying with calcium was suggested to refine the silicon structure. Calcium will reduce the castability but this can be explored.

Reviewer 3:
This reviewer observed a need to increase section sizes, and determine what types of automotive structural components are being targeted. The reviewer added that this project should guide what further type of component-level testing will be needed.

Reviewer 4:
The reviewer remarked that forward direction seems clear building on current success; this includes the scaling up to actual part size product, which will aid to actual cost estimates. Also, the reviewer stated that no decision points were given for any course correction.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer said lightweighting.

Reviewer 2:
This reviewer indicated that the process to reduce cost can only create limited shapes, but still appropriate for some commercial parts for weight reduction. In addition, the reviewer said the project will be scaled up to full size parts this year.

Reviewer 3:

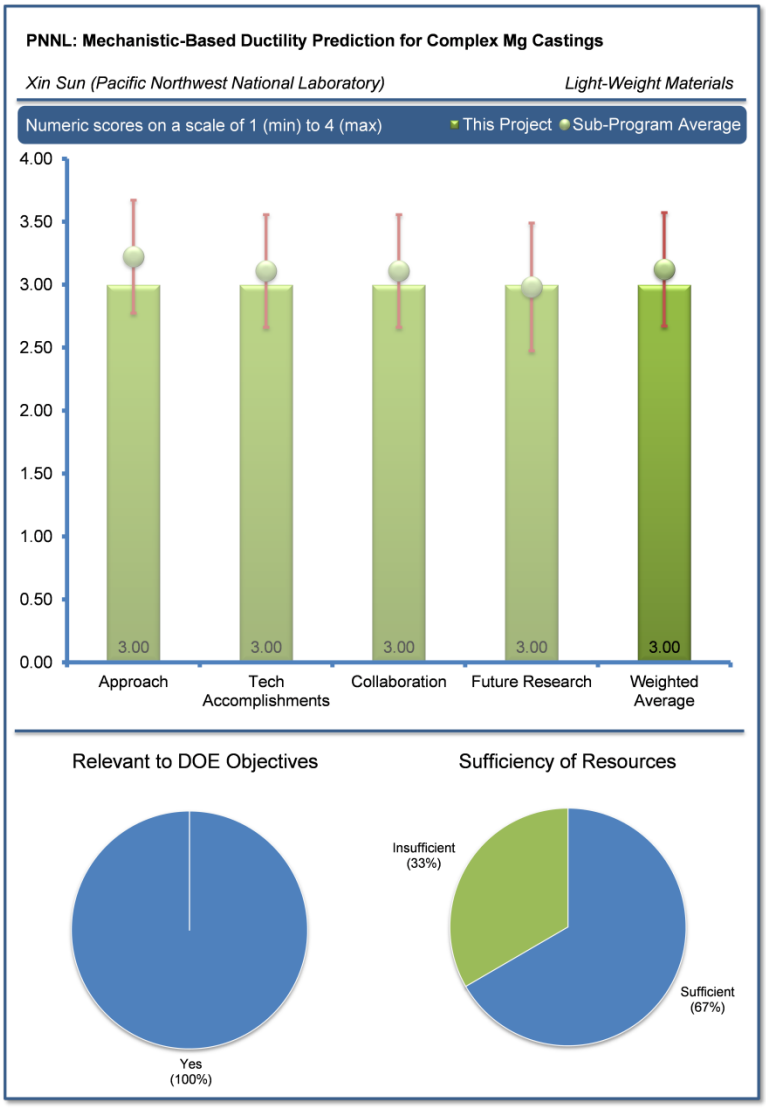
This reviewer commented that rare earth metals can strengthen Mg alloys but the cost and availability of these materials is questionable. The reviewer added that efforts to improve the strength of Mg without the use of rare earth metals will significantly improve the feasibility of using these materials in vehicles.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:

This reviewer stated that the team seems to have the appropriate technical resources, and the increased funding level combined with industrial in-kind should be sufficient for the next years' work.

PNNL: Mechanistic-Based Ductility Prediction for Complex Mg Castings: Xin Sun (Pacific Northwest National Laboratory) - lm057



Reviewer Sample Size

A total of three reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer said that the project team had a very good and sound approach as far as the modeling of the Mg alloys is concerned. The reviewer added Mg alloys are good candidates for lightweighting materials. The reviewer's hesitation for an outstanding score is related to the fact that there are no target specifications for these alloys and, therefore, the castings appear to serve only the modeling. This is important but producing castings with respect to target specifications is more relevant.

Reviewer 2:

This reviewer pointed out that a mechanistic model would be a dramatic improvement; the reviewer was unclear how the necessary input parameters will be determined. The reviewer stated that overall the project draws heavily from experimentation, but the reviewer did not see how the modeling work will be fed back to affect the experimental work.

Reviewer 3:

This reviewer opined that the work at Pacific Northwest National Laboratory (PNNL) always seems to be brute-force modeling of a particular system from which no generalizable insights can be drawn.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer stated that the progress is indeed excellent.

Reviewer 2:

This reviewer is concerned that the combination of creating a mechanistic-based model and creating a model that includes the ductility variation may be too ambitious for the time remaining.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer doubts that Ford is the only car maker interested in Mg alloys and their castings. This reviewer stated that to be fully relevant, all car makers should be involved in such research. The reviewer commented that publications are good for PNNL but what really matters here is generally not published.

Reviewer 2:
This reviewer observed that other participants do not seem as deeply involved as personnel at PNNL.

Reviewer 3:
This reviewer stated that not many details were provided other than Ford cast the parts, and Michigan modeled this.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer commented that the modeling of Mg castings is getting refined and/or improved.

Reviewer 2:
This reviewer pointed out that the remaining goals seem very broad and appear to be a large challenge to complete.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer said of course, it does.

Reviewer 2:
This reviewer stated that if the goal of a mechanistic-based predictive model can be realized, this will allow lighter Mg alloys to be evaluated more easily.

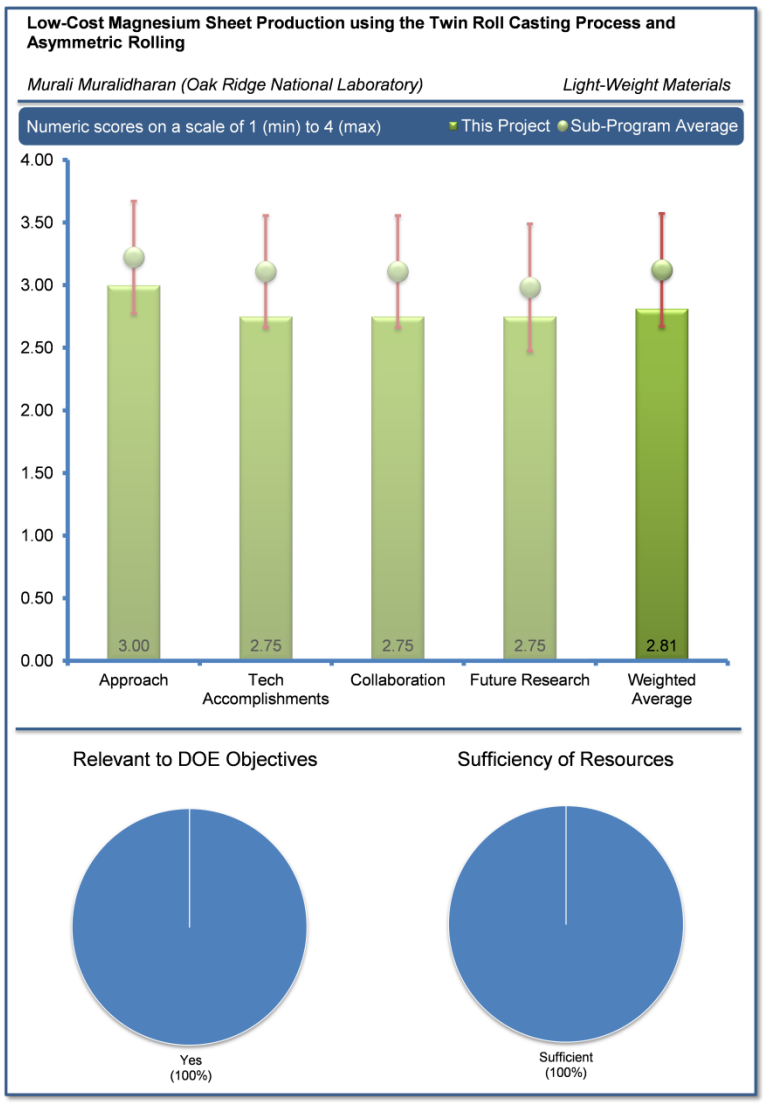
Reviewer 3:
This reviewer observed that this topic needs to be addressed, but the reviewer was not sure if the brute-force models that are being produced are extensible beyond the experimental space within which they were taught.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer commented that linking the properties into the model seems to be the key for this project's effectiveness. The reviewer added that in light of the long list of work to be completed, it is not clear that this element of the project will get the attention necessary to complete it.

Reviewer 2:
This reviewer said probably.

Low-Cost Magnesium Sheet Production using the Twin Roll Casting Process and Asymmetric Rolling: Murali Muralidharan (Oak Ridge National Laboratory) - lm058



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer indicated that the approach seemed to be based in the idea that twin roll casting would reduce the cost of Mg sheet material, but how this occurs was not clear. Similarly, the reviewer did not see a strong predictive modeling component to the work.

Reviewer 2:

While this may be a good approach, this reviewer observed wanting to do too much and give too much detail, and further expressed difficulty in extracting the essence of the project. The reviewer inquired about the minimum sheet dimensions required by car makers. The reviewer also asked about the target price per sheet of interest to car makers.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer stated that the accomplishments were difficult to deconvolve from the presentation, and that many were presented with little experimental data to back them up.

Reviewer 2:

The reviewer sees this project more like a lab exercise rather than industrial research. To the reviewer, the absence of any car maker as a partner is not good.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

This reviewer stated that car makers should be involved in such a project; otherwise, this indicates a lack of interest from them.

Reviewer 2:

The reviewer indicated it was not clear how strong the collaborations were beyond supply of material.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer remarked that it would be helpful if the future work included a formability evaluation of small sheet components beyond the current dome test.

Reviewer 2:
This reviewer said that there seems to be more future research planned than there is time to work on.

Reviewer 3:
This reviewer indicated that it was more of the same, and that the project should be either abandoned for now or restructured from its inception with input from end users. The reviewer then asked with respect to what is the product low cost.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer said definitely.

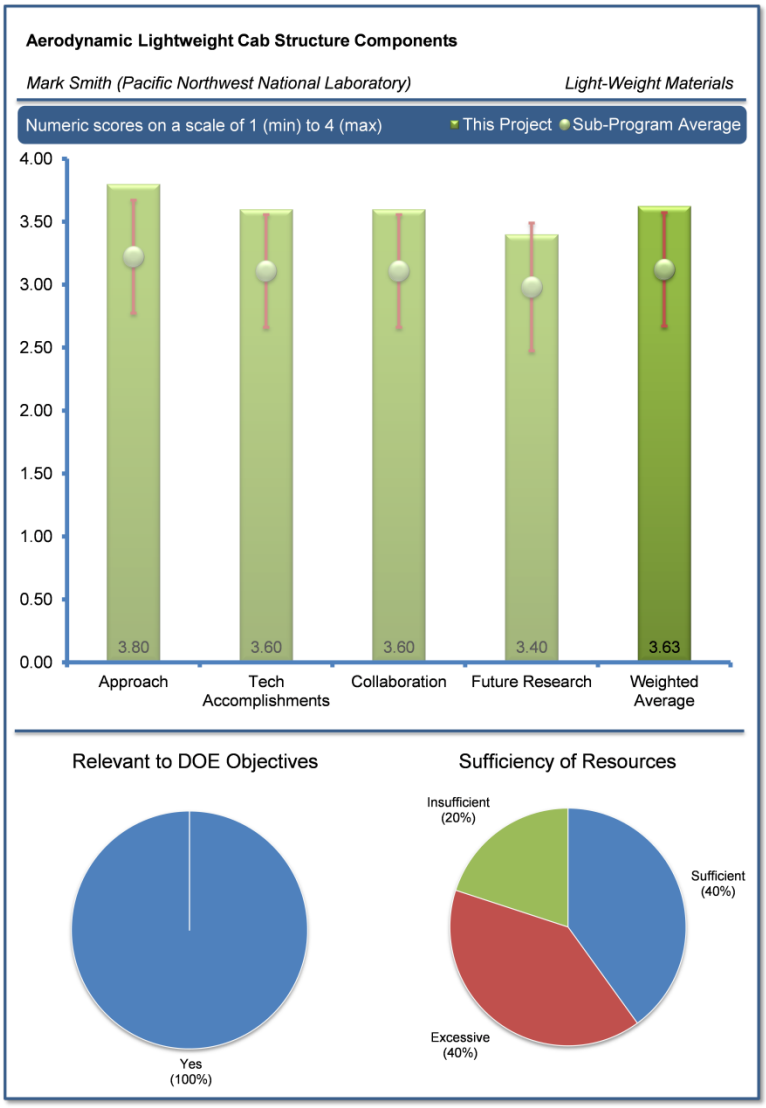
Reviewer 2:
This reviewer indicated that from the presentation the petroleum displacement from this technique would seem to be rather modest.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer observed that it was not clear what milestones remained.

Reviewer 2:
The reviewer stated sufficient but just like low cost, the reviewer did not really know what it means.

Aerodynamic Lightweight Cab Structure Components: Mark Smith (Pacific Northwest National Laboratory) - lm060



Reviewer Sample Size

A total of five reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer stated that it is definitely a good project: reducing truck cabin weight by up to 40% is outstanding.

Reviewer 2:

The reviewer commented the approach was good. The reviewer added that this speaker focuses on practical issues and plans for eventual implementation by industry which is precisely the right approach in the reviewer's view.

Reviewer 3:

The reviewer stated that the combination of some hot and cold forming has been demonstrated as a reasonable solution to the forming of complex/aerodynamic parts with weight savings as compared to the current sheet model compound (SMC). Also, the reviewer observed that scaling up has been scheduled for this year and that the low production numbers are sufficient for the market being considered here. Additionally the reviewer indicated that the cost for the energy to hot-form the parts could limit wider application.

Reviewer 4:

This reviewer stated the overall approach seems reasonable, and seems likely be a pathway for use. The reviewer added that there will likely be other issues for full production that will be encountered as the die design failure shows.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer observed excellent work and that the project seems very solid.

Reviewer 2:

This reviewer stated the progress toward a successful final part has been very good, and fast with quick down-sampling of options. The reviewer added that this might be in part that the required 40% savings was not a difficult target. The reviewer said it seems like the project will likely be fully successful, but could do significantly more technical accomplishments in optimizing the result if a wider view of options is considered (other alloys larger matrix of hot-forming/cold-forming combinations). The reviewer stated that PACCAR has set some limits that are more risk-averse then might be really needed.

Reviewer 3:
This reviewer said the project seems on track.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer indicated that the project looks to be very effective and that the project team has a strong plan to pass the technology over to industry. The reviewer pointed out that it would be good to see if this technology could be migrated over to higher volume applications such as light truck and passenger car (presently the project is aimed at Class VIII truck cabs).

Reviewer 2:
The reviewer remarked that the addition of Magna seems to have rounded out the team skills needed to make the project successful, especially at the current stage of making a demonstration part for testing.

Reviewer 3:
This reviewer stated that the number of collaborators was small, but well-focused.

Reviewer 4:
The reviewer opined that the fact that PACCAR is part of the project is really what matters here. As a side note, the reviewer would have liked to see more than one Al producer/furnisher.

Reviewer 5:
The reviewer recommended work with Magna to identify other potential vehicle structures with this process that can be used.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
The reviewer stated that the project looks to be very good. The reviewer advised that the team keeps their eyes on the wider applications to larger volume industry segments.

Reviewer 2:
This reviewer said that the plan for future work is well specified and seems in line with current work.

Reviewer 3:
This reviewer indicated that the plan forward with Magna suggests the possibility of other alloys that could be considered. The reviewer said that the work on an actual part to be tested should decide if the method can be successful to achieve the overall project objectives. The reviewer also noted that no specific decision points were given.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer stated that the mass savings are good as well as the additive effects of improved aerodynamics.

Reviewer 2:
This reviewer indicated that the project was definitely a good fit in the petroleum displacement agenda.

Reviewer 3:
The reviewer stated that although the project makes one particular part lightweight, its real strength is opening the market for other replacement parts in long-haul trucks.

Reviewer 4:
The reviewer listed the following: weight saving; aerodynamic profile; and finish.

Reviewer 5:
This reviewer remarked that the project team should show how this project is being used to eliminate technical barriers in the SuperTruck project.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

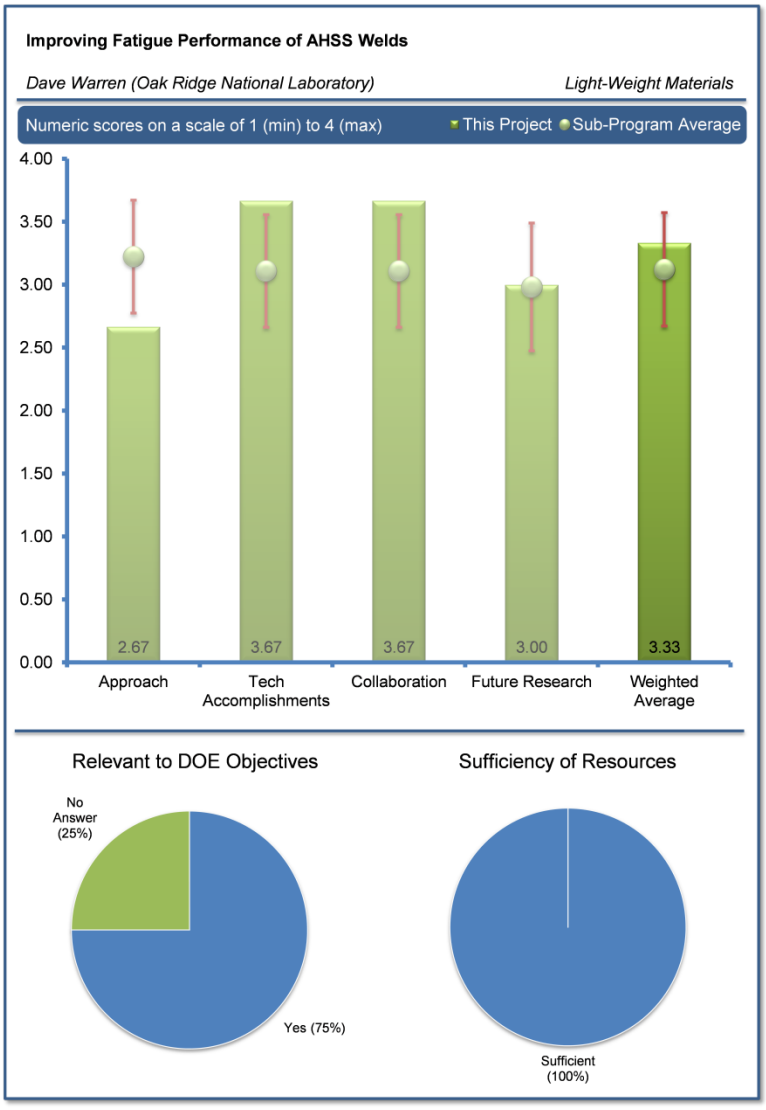
Reviewer 1:
The reviewer pointed out that the promise of the implementation of such technologies should be fully exploited, not limited. The reviewer added that when one considers the importance of trucks in this country, it appears that the savings can be enormous.

Reviewer 2:
This reviewer said that for the scope of the work, the project resources seem appropriate, but the reviewer thinks there is room for more resources to improve this project as it is well-defined and managed.

Reviewer 3:
The reviewer remarked that no issues were perceived.

Reviewer 4:
The reviewer indicated that it seems like the project could do more if the partners would be willing to go a little more out of their comfort zone.

Improving Fatigue Performance of AHSS Welds: Dave Warren (Oak Ridge National Laboratory) - lm062



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer stated that the project team had a good project design to understand barriers as well as ORNL, material supplier, university and weld equipment supplier.

Reviewer 2:

The reviewer indicated that the project team was taking a sound scientific approach to develop technologies that can eliminate the root cause of premature fatigue of AHSS; however, the project appears to lack quantifiable goals. Thus, any improvement could be considered a success. Also, the reviewer recommended that specific targets for improvement should have been developed based on the literature search.

Reviewer 3:

The reviewer pointed out that the project does a fair job of addressing the barriers identified. The reviewer does not see any effort addressing the project's third barrier, D, Predictive Modeling Tools, in this project. Additionally, the reviewer stated that the barriers are real and the work proposed starts to address the first two barriers. The reviewer remarked that since there was little discussion on how the different filler materials were chosen, it is difficult to evaluate the approach. Aside from the 10Cr (chromium)-10Ni (nickel) developed in the 2003 publication, there is no indication on the approach to develop the filler wire. Also, there is no mention of the thermo-mechanical weld process control concepts for improving fatigue life. The reviewer suggested that the project might need to look at corrosion resistance of the weld as well as the fatigue performance.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

The reviewer indicated that the project was a good accomplishment; the best is yet to evolve.

Reviewer 2:

The reviewer indicated that there appears to be good progress in developing new low transformation temperature (LTT) filler wires. The reviewer added that the investigator claims to have identified a new method to control the stress distribution at the weld beginning and end (but what the method is and its robustness are not explained).

Reviewer 3:
The reviewer stated that since the project timeline appears to have slipped by 7 months in the last 12 months since the 2012 AMR, the reviewer presumes the progress is less than half the expectation. At the 2012 AMR the Year 2 (3/12-2/13) milestones were already started and now in this 2013 AMR the Phase 2 (3/12-9/13) are the identical milestones and are listed as in progress. The reviewer pointed out that there is good evidence of some progress on residual stress measurement and some data on weld fatigue life testing. The reviewer said that the influence of the start and stop region is mentioned but not quantified. The reviewer said there are clearly issues with measuring the residual stresses in the weld toe. The reviewer concluded that the digital image correlation (DIC) information is not clearly identified as valuable.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer commended a great project team; the vertical structure always yields positive results.

Reviewer 2:
This reviewer stated that it appears the major participants have clearly defined roles and are actively participating.

Reviewer 3:
This reviewer indicated that the collaborators are certainly the correct gang to tackle this problem. The reviewer added there is insufficient information on the work at Colorado School of Mines so it is difficult to evaluate the effectiveness of the collaborations.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer said the plan is great, execution and cost effective implementation are the next steps.

Reviewer 2:
This reviewer stated that the basic plan is sound to demonstrate technical feasibility; however, the reviewer felt it is overly optimistic to think that the project team will be ready to develop robust guidelines that could be applied widely in automotive body structure fabrication, based on what appears to be only coupon level and limited component testing.

Reviewer 3:
The reviewer stated that this is difficult to rate because the future work in this 2013 AMR are the identical tasks identified as future work a year ago at the 2012 AMR. The reviewer added that the task list sounds good, but there is little evidence of any effort or concepts addressing the welding process control aspects.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer stated that this project incorporates a couple of novel approaches that will allow the auto companies to take more complete advantage of the added strength of AHSS. The reviewer added that this will enable more widespread use to reduce vehicle mass.

Reviewer 2:
This reviewer remarked that AHSS is a significant part of the multi-material architecture of the future.

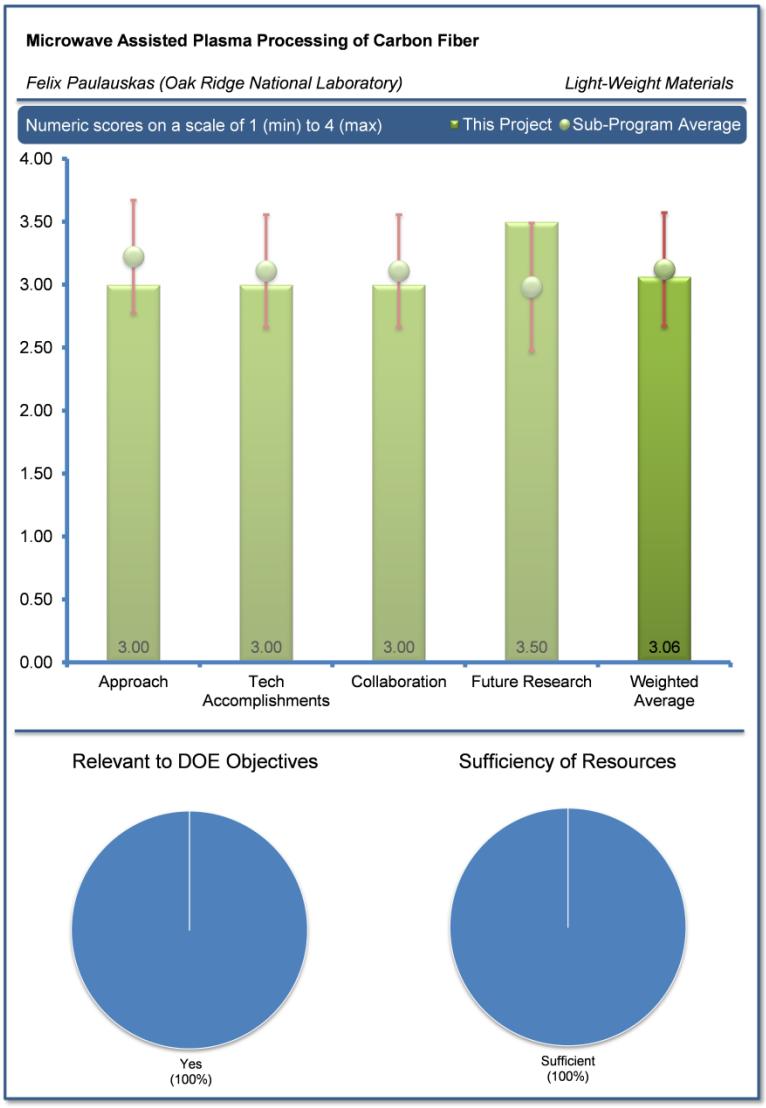
Reviewer 3:
This reviewer said that fatigue capacity and residual stress control is critical.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:

This reviewer indicated that the money appears to be okay but the lack of progress over the last 12 months indicates to the reviewer that something is not going right. The reviewer stated the project leaders need to be forthright about the resources, technical difficulties or whatever has delayed progress.

Microwave Assisted Plasma Processing of Carbon Fiber: Felix Paulauskas (Oak Ridge National Laboratory) - lm069



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer commented that the approach is solid and attacks a key element of CF cost.

Reviewer 2:

This reviewer indicated that the microwave assisted plasma (MAP) process looks very promising; however, the potential for atmospheric processing should be the primary focus. The reviewer stated that this project is an excellent body of work and should be continued, with excellent science and parallel process development.

Reviewer 3:

The reviewer was not quite sure if working on this topic is justified; based on CF cost analysis, its total cost impact is 14 %

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

The reviewer stated that smart people always make good progress.

Reviewer 2:

The reviewer observed that assuming the properties presented are repeatable, this process offers a lot of potential for improved properties, supplementing the cost savings work, which is part of the LCCF projects at ORNL.

Reviewer 3:

The reviewer indicated that recent results appear promising, but there are still significant barriers that need to be addressed (i.e., varying tension in tows).

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer stated that continued collaboration with plasma supplier should occur.

Reviewer 2:
The reviewer indicated due to export control, it is understood that collaboration is limited, but is still respectable.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
The reviewer pointed out that the outline of future work is right on track. The reviewer is looking forward to positive results from the next phase of the project.

Reviewer 2:
The reviewer stated that the project team should consider future funding to integrate this project into the CFTF, scaling this project is the next step and worth exploring.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

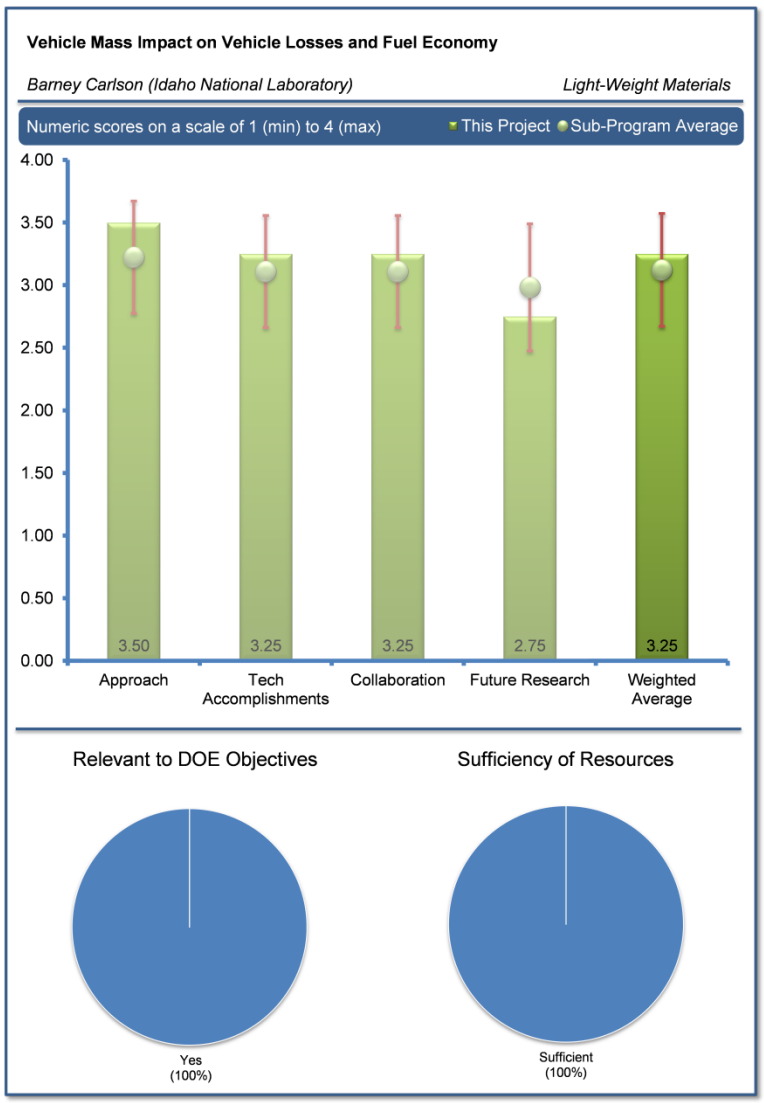
Reviewer 1:
This reviewer indicated that this project is in line with DOE's efforts to develop LCCF for lightweight structural applications for automotive and other industries.

Reviewer 2:
This reviewer observed that this project directly feeds the vehicle lightweighting initiatives.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer said this project looks to be well funded and should continue.

Vehicle Mass Impact on Vehicle Losses and Fuel Economy: Barney Carlson (Idaho National Laboratory) - lm070



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer indicated that many aspects were considered in setting up the experiments; care had been taken to account for variability and impact of many variables which can affect the results. Also, the reviewer stated even though the addition or removal of the weight is not explained properly the vehicle level was maintained closer for all weight conditions.

Reviewer 2:

The reviewer remarked that the experiment design was great. The reviewer emphasized the need to know versus believe.

Reviewer 3:

The reviewer stated that this project is a good parallel study to what the OEMs currently do, and it helped to confirm what is known about weight reduction for an internal combustion engine (ICE), hybrid, and battery electric vehicle (BEV).

Reviewer 4:

This reviewer noted this project was a very complicated topic to address.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer commented that this project was a good body of work and met the DOE objectives.

Reviewer 2:

This reviewer said good effort.

Reviewer 3:

This reviewer commented that the results have proven the earlier empirical studies on the benefits of light-weighting. The reviewer that said it is significant to see even EV or hybrid powertrains can benefit from lightweighting even though less compared to ICE.

Reviewer 4:
The reviewer said the barriers were low but were overcome. The reviewer strongly encouraged determining the impact of transmission and rear axle fluid as well as the effect of ethanol.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that a research study of this nature has involved many participants, including OEMs who had provided test tracks and facilities.

Reviewer 2:
This reviewer said good collaboration; however, these vehicles are now outdated, in other words, the fusions tested are the older versions, with the new one offering significantly better FE using engines that are downsized and boosted.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer said that the project is complete and that no new funding is being requested.

Reviewer 2:
The reviewer strongly encouraged evolving the test protocol to determine the effect of temperature pre-conditioning of transmission and differential fluids. This is a significant contributor. The reviewer questioned why BMW uses radiator fluid to control transmission oil temperature. The reviewer noted that for BEVs we need built-in preconditioning of the drivetrain fluids. The reviewer stated that the impact may be as much as 12% increase in range or FE, specifically at highway speeds

Reviewer 3:
This reviewer remarked that the Idaho National Laboratory (INL) is encouraged to continue to develop expertise in accurate testing and measurements of FE, but discouraged from modeling and making forward product assumptions on FE, emissions, etc. The reviewer added the project team might want to consider these vehicles as benchmarked and accurately measured. The reviewer said to now use them to evaluate specific changes like use of low rolling resistant tires, air flow shutter, etc. (i.e., ancillary adds to a vehicle that should improve FE).

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer said absolutely, with emphasis.

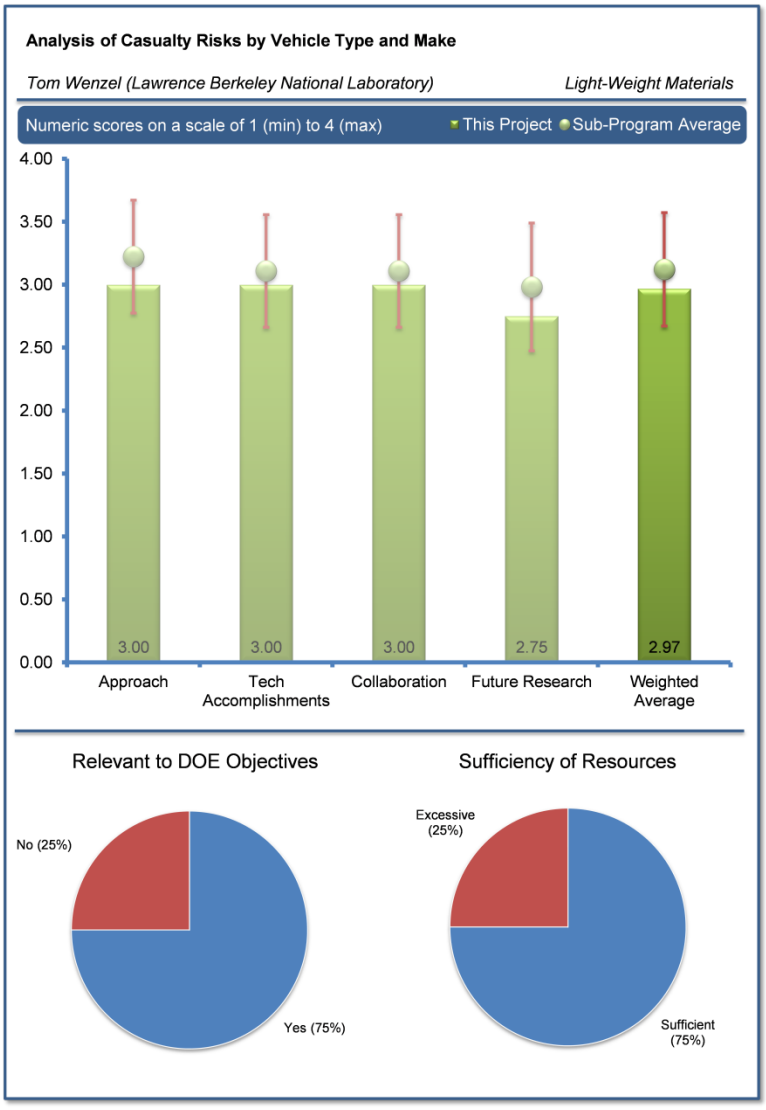
Reviewer 2:
This reviewer stated understanding the effect of many driving variables and light- weighting on the fuel/range efficiency is important. This will help policy makers to develop regulations reflecting reality.

Reviewer 3:
The reviewer commented that this project does contribute to our understanding of mass versus FE.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer stated that any additional funding should secure input from OEMs on what needs to be measured.

Analysis of Casualty Risks by Vehicle Type and Make: Tom Wenzel (Lawrence Berkeley National Laboratory) - lm071



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

The reviewer stated that this was a good approach on comparing insights from two different, both reasonable, statistical studies. The reviewer noted that the project team needs more efforts in separating weight from footprint. The reviewer then asked since they are so well correlated in the fleet at this time, can the results be statistically separated with high confidence.

Reviewer 2:

The reviewer said that the project is a statistical analysis to study the effect of light weight and fatalities. This reviewer noted that even though the data available is very limited the study concluded light-weighting has minimal risk, which is outweighed by other factors such as drivers, night driving, etc.

Reviewer 3:

Though the overall approach of the work is very good, the reviewer would have liked to see fewer variables. This reviewer explained that the more variables one has, the more multi-correlations one has, and the more difficult they are to give a clear picture of the sought-after effects. In the reviewer's mind, every effort should be made to limit the number of variables, and when a variable can be replaced by a measurement, then the measurement should be used as a parameter in the fitting. For instance, the reviewer does not understand why the weight should be a variable. The reviewer is convinced that there were other variables that could be replaced by parameters.

Reviewer 4:

This reviewer remarked that the methodology of this study does appear to be improved over the previous study; however, the reviewer failed to see how an estimate of how changes in weight and size of past vehicles will enable National Highway Traffic Safety Administration (NHTSA) and the U.S. Environmental Protection Agency (EPA) to set new vehicle standards that will encourage down-weighting of vehicles without affecting safety, or how such standards would encourage manufacturers to use advanced lightweight materials to reduce new vehicle weight without necessarily reducing size. Additionally, the reviewer noted that if the study did show a correlation between risk and reduced mass and/ or size, it would simply encourage consumers to buy larger, and/or heavier vehicles, which is contrary to DOE's desire to increase vehicle efficiency. The reviewer commented that if the study does not show a correlation (as is the case) it provides no motivation for consumers to buy smaller or lighter vehicles.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:
This reviewer remarked that the regression analysis is very systematic and thorough. The reviewer added that the results were confirmed by other studies and have been used for EPA regulation for future vehicles.

Reviewer 2:
The reviewer said that the project team made good progress completing the 2012 reports and updates. Additionally, the reviewer said the project is on track with the deliverables.

Reviewer 3:
This reviewer observed that much analysis has been completed.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer remarked that the effort to collaborate with other agencies should be commended and encouraged.

Reviewer 2:
This reviewer stated that the project has worked or consulted with many regulating agencies, including EPA and NHTSA.

Reviewer 3:
This reviewer commented that the list of collaborators is strong. The reviewer would like to see more details on the deliverables and the gives and gets from each of the collaborators.

Reviewer 4:
This reviewer commented that although close work with NHTSA and EPA is cited, it is not apparent what those groups contributed to the project. The reviewer added that it appears that the work was done for them rather than with them.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer remarked that the proposed work for the last portion of the project appears to accurately address the most pressing needs. The reviewer wanted to see more details on what other statistical analyses could be done to illuminate the study of risk after vehicle redesign.

Reviewer 2:
This reviewer thinks that such a study should be continued with premises to be revisited.

Reviewer 3:
This reviewer stated that further analysis needs to be done to confirm or correct discrepancies.

Reviewer 4:
The reviewer pointed out that the study has shown that the effects of mass and/or footprint are negligible, especially in comparison to several other factors considered. Thus there is no apparent reason to continue a study that appears to be trying to create a simple (and assumed negative) correlation, where none actually appears to exist.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer said absolutely, and further effort ought to be considered.

Reviewer 2:
This reviewer remarked that this project is an important adjunct question on how lightweighting effects society.

Reviewer 3:
This reviewer stated that it is necessary to know the implication of strict fuel efficiency rules which may call for lightweighting. The reviewer remarked that if lightweighting causes more fatalities it will be counterintuitive to call for such action. The reviewer commented that this study reveals no significant increase in risk of fatalities due to lightweighting by analyzing actual accident data.

Reviewer 4:
The reviewer described this study as a lose-lose proposition for DOE. The reviewer added that if the study did show a correlation between increased risk and reduced mass and/or size, it would simply encourage consumers to buy larger, and/or heavier vehicles, which is contrary to DOE's desire to increase vehicle efficiency. The reviewer said that if the study does not show a correlation (as is the case) it provides no motivation for consumers to buy smaller or lighter vehicles.

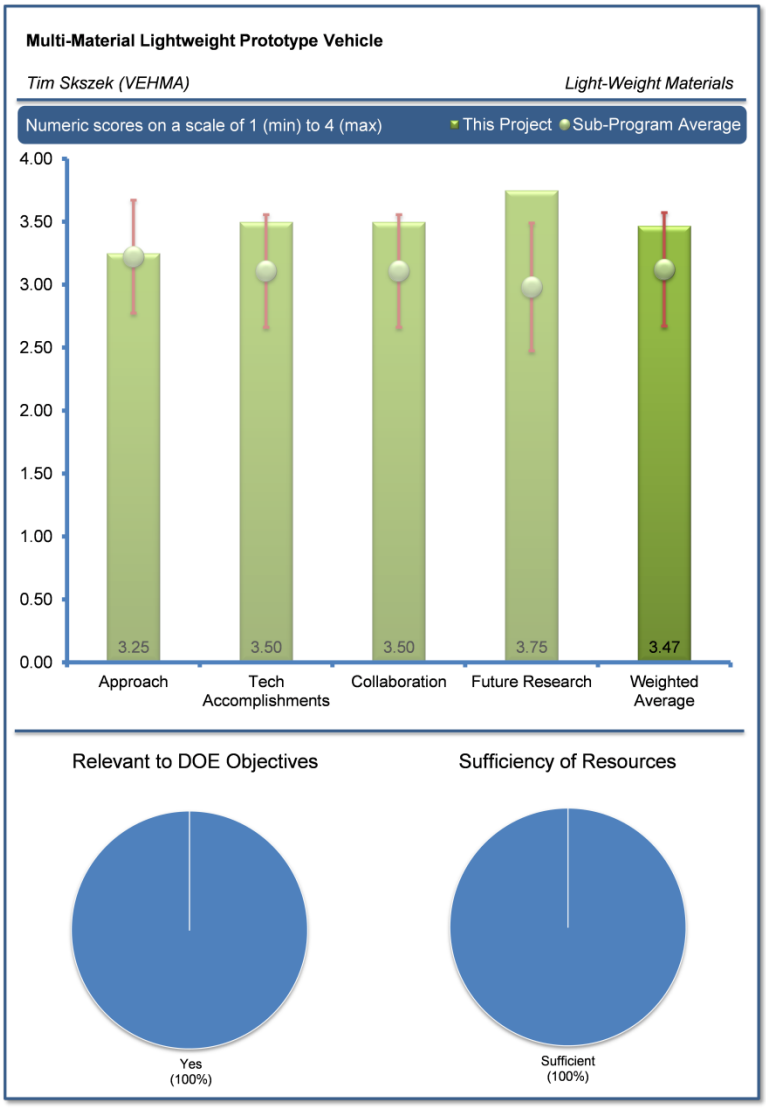
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer said that the presenter did not complain about the level of funding (i.e., the funding is sufficient).

Reviewer 2:
This reviewer said resources appear to be sufficient.

Reviewer 3:
The reviewer opined that spending close to $1 million on this study is not a reasonable use of funds that could have been better spent on researching technologies that could improve vehicle efficiency.

Multi-Material Lightweight Prototype Vehicle: Tim Skszek (VEHMA) - lm072



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

The reviewer remarked that the multi-material design is the way to go.

Reviewer 2:

The reviewer stated that there was a massive amount of information for delivery in 20 minutes. The reviewer added that the project team seems to know what they are doing and have people on board to cover all the technical areas. The reviewer likely would be able to give this a four if the reviewer had more information.

Reviewer 3:

The reviewer stated that it was outstanding; however, with such a huge program, the presenter could only keep summarizing the accomplishments, not only during the presentation but also in the slides. The reviewer remarked it would be better for DOE and the Principal Investigator (PI) to agree on a subject, i.e., say joining, and let the PI delve into that particular sub-subject.

Reviewer 4:

This reviewer stated that while being a good and ambitious plan, demonstration of mass savings falls short of the 50% mass savings targeted in the original funding opportunity. Also, the reviewer said the Mach I design is aimed at only a 37-40% mass reduction. In addition, the project team has given themselves a 10-12% buffer due to using a 2012 vehicle as the starting point for the prototype. Thus, the target has been reduced to only a 25-30% mass reduction. The reviewer added that the Mach I also plans to use many current technologies (Al and AHSS materials, conventional joining methods, etc.) rather than pushing the technology envelope. The reviewer stated that there is no indication that the Mach II design (aimed at a 50% mass savings) will be anything more than a (concept) paper study. Thus, there will be no way to evaluate the accuracy of the projected weight savings or performance of that vehicle. The reviewer stated that such a study can be done today. The reviewer said that there was no mention of a cost assessment. If one is not included in the work plan, it should be added.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer said that the project sounds very impressive.

Reviewer 2:
This reviewer indicated that Mach 1 only achieved 22% mass reduction. The reviewer added that the original Funding Opportunity Announcement (FOA) called for the build of 50% mass reduction vehicle. The reviewer stated that the current build of 22% is way below the original goal. The technologies chosen in Mach 1 build are essentially all in commercial production. Therefore, there is very limited learning in Mach 1 build and test. The reviewer then added that although the Mach 2 is targeted for 50% mass reduction, it will not be built and tested (unfortunately).

Reviewer 3:
This reviewer remarked that although much progress has been made in executing the project as designed, the basic plan is flawed in that it does not strive to demonstrate a 50% mass savings.

Reviewer 4:
This reviewer commented that if past performance indicates future productivity, the fact that the project team has met their marks so far is good. The reviewer observed that there was not much indication in the presentation or in the unbelievably dense overheads to be able to predict how well the project team will do going forward as things get more complicated. The reviewer commented that the project team seems to be making their marks. The reviewer was unaware of the scope of the project, specifically whether the project team needs to address if this one-off development needs to be demonstrated as viable for mass production, which would be a concern.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer stated that it was good to note that the project team reports no hang-ups due to collaboration issues and shortcomings.

Reviewer 2:
This reviewer indicated that the project appears to have well-coordinated and integrated activities at Ford and Vehma. The reviewer noted that it also appears there are numerous suppliers involved, but it is not clear to what extent they are contributing.

Reviewer 3:
This reviewer found it somewhat bothersome that only Ford is present as a participant. The reviewer stated that this probably reduces the extent of the overall finding for such a project. Also, the reviewer added that to be fair, DOE should consider similar projects with the other car makers.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer indicated that the project seems to be comprehensive and added that more information on the Mach 2 would have been useful.

Reviewer 2:
This reviewer stated that a logical and thorough plan has been laid out to deliver Mach I prototypes; however, the project fails to be aggressive enough to reach a 50% mass save as specified in the original Funding Announcement. The reviewer added that the plans do not appear to include an assessment of cost impact of the Mach I or Mach II lightweighting efforts. The reviewer suggested that it should include both to be complete.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer indicated that even a 25% mass reduction is significant in reducing energy consumption.

Reviewer 2:
This reviewer stated mass reduction.

Reviewer 3:
This reviewer said definitely, but as the car makers compensate the weight savings with comfort weight, one wonders.

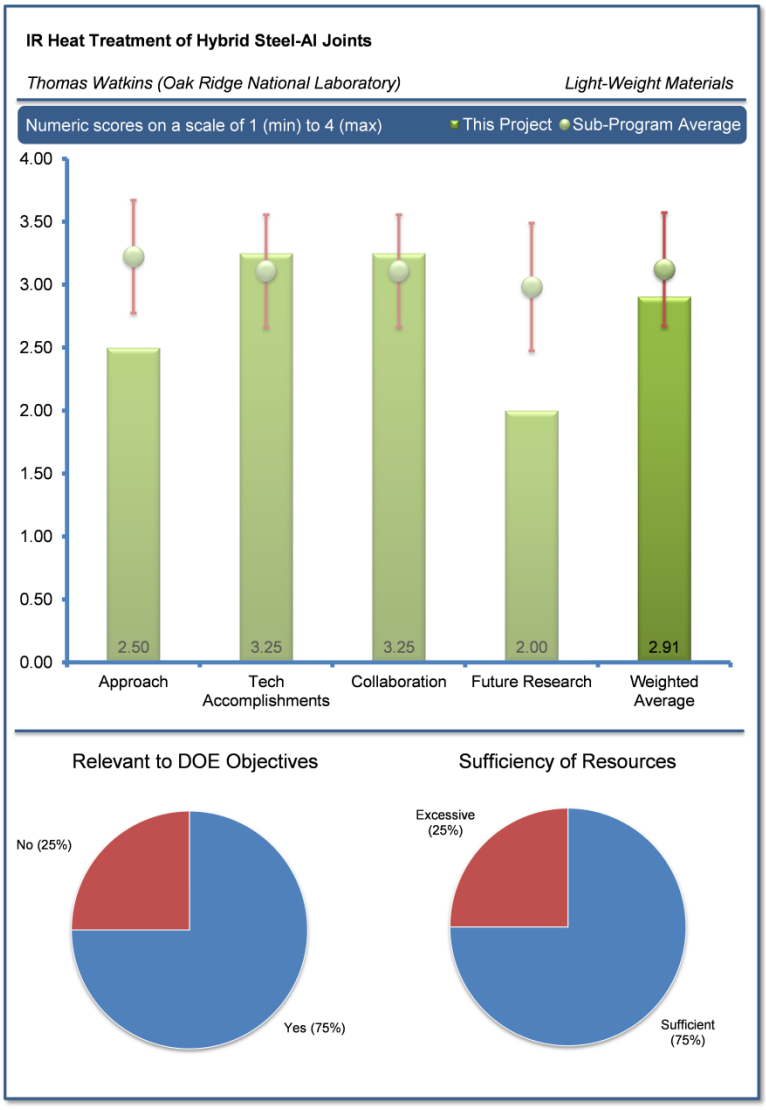
Reviewer 4:
This reviewer commented that obviously for all the lightweighting work being done on various pieces, you need to put a whole car together to be able to address the various integration issues: dissimilar materials joining and corrosion, crash energy management, etc.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer stated that the recourses seem about right. The reviewer added that this project is going to be an expensive undertaking.

Reviewer 2:
This reviewer had no complaints, so it is adequate, but the reviewer is sure the project team could use more.

IR Heat Treatment of Hybrid Steel-Al Joints: Thomas Watkins (Oak Ridge National Laboratory) - lm073



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer commented that the project is aimed to measure the residual stress in a bimetallic component. The reviewer said that only one type of joint is considered and only one assessment technique, neutron diffraction, was considered. The reviewer added that it is better to test the freeform samples as well various process conditions to compare the stress development. The reviewer pointed out that another testing type needs to be used to confirm the validity of the new technique.

Reviewer 2:

This reviewer observed that the approach is missing a key aspect of incorporating bimetallic joints into lightweight vehicle design, corrosion. The reviewer remarked casting Al over steel has many strength advantages for mixed metal joining. The largest impediment has always been the corrosion performance of such a system.

Reviewer 3:

This reviewer stated that it is not clear what was done and what the findings have been. It appears that the entire purpose of the work was to exercise characterization tools formerly maintained by the High Temperature Materials Laboratory (HTML), without a vision for how the results would be used to increase the implementation of lightweight materials.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer observed that strong progress has been made toward the stated goals. The reviewer stated that the neutron-based investigation of strains is particularly interesting. The reviewer wanted to see a bit more explanation, perhaps in the technical backup or reviewer slides of how the residual stresses were obtained. The reviewer pointed out that there should have been more information on the process for the high pressure die casting over the steel tube.

Reviewer 2:

This reviewer said that it is difficult to determine the progress from the limited information provided. This reviewer added that from comments during the Question and Answer (Q&A) it appears that it was determined that the Al is not simply a shrink fit on the steel tube, which could be a significant finding.

Reviewer 3:
This reviewer stated that the measurements are presented with some analysis. The reviewer added that comparing the results with another technique would be useful, and added that the effect of processing needs to be assessed.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer stated that the project team had good collaboration with their industrial partner.

Reviewer 2:
This reviewer stated that industry has provided actual test samples and that the interaction within the project team is good.

Reviewer 3:
This reviewer remarked that it appears that there was ongoing communication and coordination between Vehma and ORNL, but it is not clear how frequent the communications were. The reviewer said that because there are only two participants the reviewer would expect coordination would not be difficult.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer observed that insufficient information was provided to understand what additional modeling or joint characterizations will be done (or why or how).

Reviewer 2:
This reviewer said that no specific details were provided; if more testing methods were included, then it would have added value to the project.

Reviewer 3:
This reviewer remarked that it is not clear what the model development refers to. The presentation never discussed a model development or presented any model predictions. The future work on residual stresses is clear and necessary. The reviewer is curious why corrosion is not considered. The reviewer inquired if any work will address other bimetallic joints other than cast Al over steel sections.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer observed that bimetallic joints are a key enabler for lightweight designs.

Reviewer 2:
This reviewer stated that the manufacturing process can introduce defects or unwanted loading in the structures, which will influence the performance adversely. This reviewer pointed out that understanding the process and the structure conditions will help designers design good structures. Additionally, the reviewer said that bimetallic structures are necessary to reduce the mass of the vehicle structures, as this utilizes good properties of two different materials.

Reviewer 3:
The reviewer referenced the presentation, commenting that successful characterization of bimetallic joints will enable a 20% weight reduction relative to baseline steel, is not a realistic outcome of this project. The reviewer said that the ability to produce robust bimetallic joints may help reduce mass by easing the introduction of lighter-weight materials, but characterization of those joints will not reduce mass and will only be one small factor in introducing enough Al to enable a 20% mass reduction.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

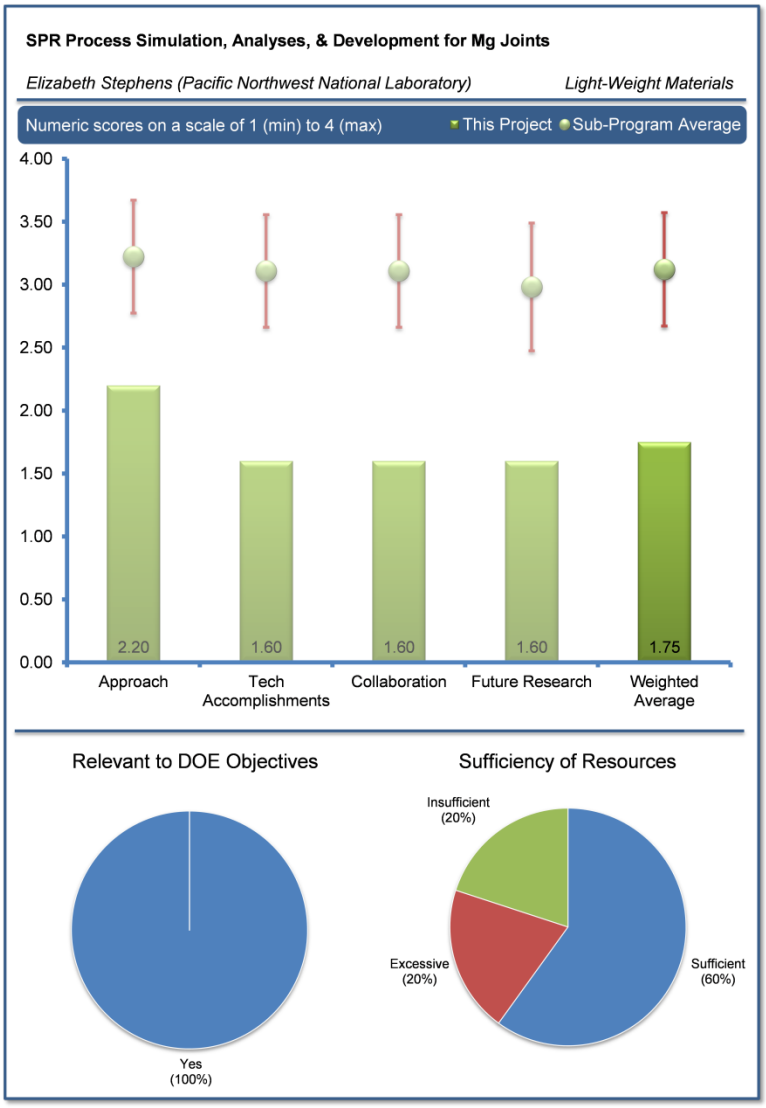
Reviewer 1:

This reviewer said that resources appear sufficient for the study as described.

Reviewer 2:

This reviewer pointed out that $1.4 million for characterization of a few joints, with no obvious path to using the method for anything but a laboratory exercise, is excessive.

SPR Process Simulation, Analyses, & Development for Mg Joints: Elizabeth Stephens (Pacific Northwest National Laboratory) - lm074



Reviewer Sample Size

A total of five reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer remarked that if heating is used for surface plasmon resonance (SPR), the reviewer would recommend working on Mg castings such as vacuum die cast AM60B, which the poor formability at room temperature is the limiting factor in SPR process.

Reviewer 2:

This reviewer indicated that the approach seems to take into account the major factors in the SPR process; however, the reviewer does not believe friction has been taken into account in the modeling. The reviewer added different rivet materials and/or rivet coatings will likely have different friction characteristics, which will influence such things as insertion force and joint performance. In addition, the reviewer stated that simply modeling the insertion process without modeling the performance of the joint will only answer half of the question of how good the joint is. Regardless of the aspects modeled, the project should include extensive testing to validate modeling predictions. The reviewer suggested that the project should also consider additional materials for the rivet and the materials to be joined. For example, Mg casting is much more prone to die-side cracking than is Mg sheet, which is the only material that currently appears to be modeled.

Reviewer 3:

This reviewer indicated the project needs to have more clearly defined objectives and deliverables. The general objective statement of, providing a reliable joining mechanism, and deliverable statement of, characterize the joint performance, is so broad it is difficult to judge the quality of the approach. The reviewer added that for SPR joints in Mg-to-Mg and also Mg-to-non-Mg stacks, a critical performance attribute is galvanic corrosion. In addition, the reviewer said that while the SPR process parameters are important to develop, a critical aspect of having SPR joints considered for automotive structures is the corrosion performance. The reviewer said that this must be explicitly described in the objectives, deliverables and approach.

Reviewer 4:

This reviewer stated that it was very hard to tell, as the project team has made so little progress doing actual work on the project. This reviewer added that the pretty pictures generated by finite element analysis (FEA) are fine, but reviewers have no way to know if the project team is on the right track even with this work.

Reviewer 5:
This reviewer stated that the project team had a very poor approach.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:
This reviewer said the project team had good progress in simulations and preliminary testing, for the limited time the project has been underway. This reviewer looks forward to seeing the results of Phase Two and the complete Phase One.

Reviewer 2:
This reviewer indicated that the accomplishments in this first year of efforts are strong in FEA models. The finite element method (FEM) analyses show that the SPR and clinching processes can be modeled effectively in LS-DYNA. The reviewer said that there is strong progress on the tools and initial efforts to characterize the process. The reviewer remarked that hopefully, the tool will correlate with the tail cracking. The reviewer advised that future efforts should also address the strength and fatigue performance of these joints. This reviewer further noted that the first room-temperature joints and observed tail cracking have been made. This reviewer said that there have been no accomplishments on the corrosion performance of the SPR joints. If corrosion is not part of the project, then this should be clearly stated. This reviewer considers corrosion a key aspect of the characterization of the joint.

Reviewer 3:
This reviewer said the project had only modeling results so far. The reviewer stated that heating mechanisms need to be defined as soon as possible.

Reviewer 4:
This reviewer pointed out that there was very little to report.

Reviewer 5:
This reviewer remarked that the project had a very slow start, which puts the whole timeline in jeopardy.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer pointed out that there is no explicit discussion of the collaboration. The reviewer added that as the project develops, it will be important to track the roles and responsibilities for process development, joint testing, joint analysis, strength predictions and testing, fatigue predictions and testing and corrosion predictions (hopefully) and testing.

Reviewer 2:
This reviewer noted Stanley and PNNL.

Reviewer 3:
This reviewer indicated that the work seemed to be very much dominated by PNNL. It is not apparent to what extent Emhart has been actively involved or contributing.

Reviewer 4:
This reviewer said that the project took a long time to reach a Cooperative Research and Development Agreement (CRADA).

Reviewer 5:
This reviewer indicated that a project where the two principals take two years, half the term of the project, to simply get a legal agreement in place, is extremely troubling. The reviewer added that doing clinching research where it is apparent that PNNL thinks that is a waste of time is doubly-so.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer remarked that the project team needs to include Mg castings, Mg-to-Al, and Mg-to-steel joining.

Reviewer 2:
This reviewer observed that the partner was considering clinching, which is outside the scope of SPR.

Reviewer 3:
This reviewer stated that the plan should be expanded to include prediction (and verification) of joint performance and influence of rivet coatings, more alternative rivet materials, and different materials to be joined. For example, different Mg forms and the addition of Al alloys.

Reviewer 4:
This reviewer said that the future work does not address what this reviewer sees as the critical aspects of SPR joints in Mg. The reviewer added that the process parameters are probably adequately addressed, though the future work slide is not clear on this point. However, the lack of even mentioning the strength, fatigue and corrosion performance is troubling.

Reviewer 5:
This reviewer stressed that everything appears to be in the future.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer stated that joining techniques that work between Mg and other metals are obviously going to be needed going forward.

Reviewer 2:
This reviewer remarked that SPR is a mainstream joining technique for joining many lightweight materials. This reviewer added that being able to model and optimize the rivet and die geometry and material temperature without extensive testing for each new joint configuration will enable much more widespread application of those lightweight materials.

Reviewer 3:
This reviewer said lightweighting with Mg.

Reviewer 4:
This reviewer observed that the joining of Mg components, especially to steel and/or Al components, is a critical enabler for further weight reduction in automotive body, chassis and interior components. The reviewer remarked that if this project is only to develop and validate a LS-DYNA model, then it is not as relevant as the objectives imply.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

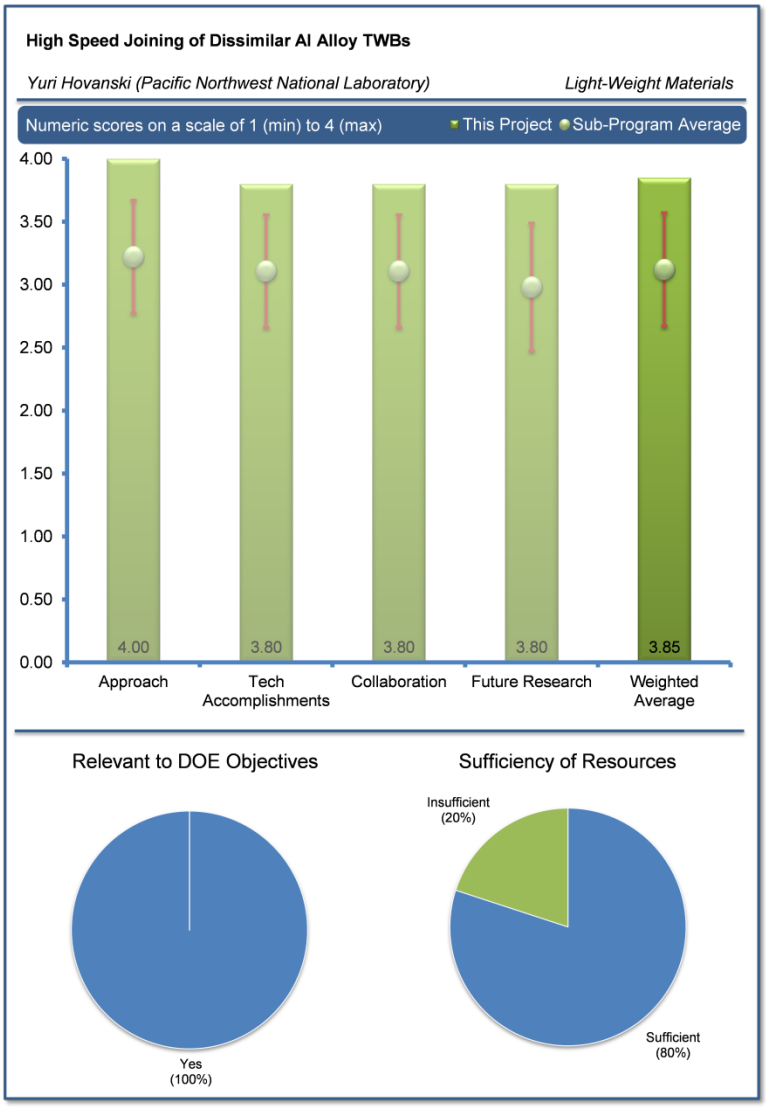
Reviewer 1:
This reviewer stated that there seems to be adequate funding and resources to attack this problem.

Reviewer 2:
This reviewer stated that the project seems to be scaled to fit the funding available rather than providing the funding that is needed to do a thorough job of being able to predict performance of SPR joints. Thus, the results will be limited to simply gaining some fundamental knowledge about how well the SPR (or clinch) flares and fills the die, which will have only limited influence on increasing the use of lightweight materials.

Reviewer 3:

This reviewer indicated that there are better ways to utilize the limited resources of the DOE labs.

High Speed Joining of Dissimilar Al Alloy TWBs: Yuri Hovanski (Pacific Northwest National Laboratory) - lm075



Reviewer Sample Size

A total of five reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer commented that this project is definitely one of the best projects of the 2013 AMR.

Reviewer 2:

The reviewer remarked that this is an excellent project with it representing the next generation to tailor welded blanks. The reviewer added that friction stir welding (FSW) is ideally suited for making tailor friction welded sheets and will have a significant impact on future Al usage in the automotive industry.

Reviewer 3:

This reviewer indicated that the approach to this project attacks the critical factors of joining dissimilar Al sheets. The reviewer added that the approach is staged to gain confidence on the easier joints and build on lessons learned to attach more difficult joints. The reviewer particularly likes the Task 3 and Task 4 efforts to get to a production capable system with an industrial supplier.

Reviewer 4:

This reviewer stated that the project team seems to have a good matrix for testing performance. The reviewer added that it would be great if the project team manages to down select one welding technique that will work at high speed production.

Reviewer 5:

This reviewer stated that it seems like a well-organized and focused project with a pretty realistic approach, although the reviewer wonders if the supplier cost modeling may be too optimistic.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer noted that the progress reported at this AMR is outstanding. This reviewer added that the dome testing and Taguchi Design of Experiment are combining to yield impressive results. The reviewer also said the characterizations of the weldments are also significant accomplishments.

Reviewer 2:
This reviewer observed that the scope and breath of materials, gages, and joining techniques is impressive and well throughout. The reviewer then said the post-testing at GM is an excellent verification of properties.

Reviewer 3:
This reviewer indicated that the project looks very good; hopefully, in the next phase the team can try to move beyond lab specimens and onto more production representative geometries.

Reviewer 4:
This reviewer stated the project is good so far.

Reviewer 5:
This reviewer said very good progress.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer observed an excellent vertical alignment of participants (i.e., OEM, PNNL, Material Supplier, and Tailor Welded Blank Supplier).

Reviewer 2:
This reviewer noted that the project looks very good from the reported activities. In addition, the reviewer stated that the non-destructive testing (NDT) work at Mississippi State University is very interesting and appears to show promise for better quality in production (always an issue in any welding-related process).

Reviewer 3:
This reviewer commented that there were clear, appropriate roles, responsibilities and deliverables from each of the collaborators.

Reviewer 4:
This reviewer stated that there was a bit of a disconnect (on purpose) on selecting welding technique, but perhaps that was for the best in that the partners stayed in their technical space.

Reviewer 5:
This is a CRADA and limited collaboration; however, the project has all of the right players in the mix to deliver this technology.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer noted that within the existing project plans, the current results and future plans are excellent. The reviewer suggested that the project team might consider adding sheet dimensional control after FSWing.

Reviewer 2:
This reviewer commented that the project team had an excellent plan for the future, and that the project team needs to consider an identical Mg program using ZEK100.

Reviewer 3:
This reviewer said the project looks good.

Reviewer 4:
This reviewer said that the project team had an ambitious schedule, and the reviewer hopes that all of the associated characterization is also going to be performed.

Reviewer 5:
This reviewer stated that the identified future work identically maps to the project plans.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer said absolutely, with emphasis.

Reviewer 2:
The reviewer commented that tailor welded blanks (TWB) are under-applied primarily because of the cost of the feedstock material, and if this project succeeds the project team will develop excellent insights into a viable high-volume production method.

Reviewer 3:
The reviewer stated that this welding process shows real promise for joining certain types of lightweight materials, and that will be crucial in the eventual adoption of these materials.

Reviewer 4:
This reviewer observed that the tailor welded Al blanks are a key enabler to further weight reduction in automotive body and closure stampings.

Reviewer 5:
This reviewer noted that this project contributes to the enabling of more Al closures of near term future vehicles.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

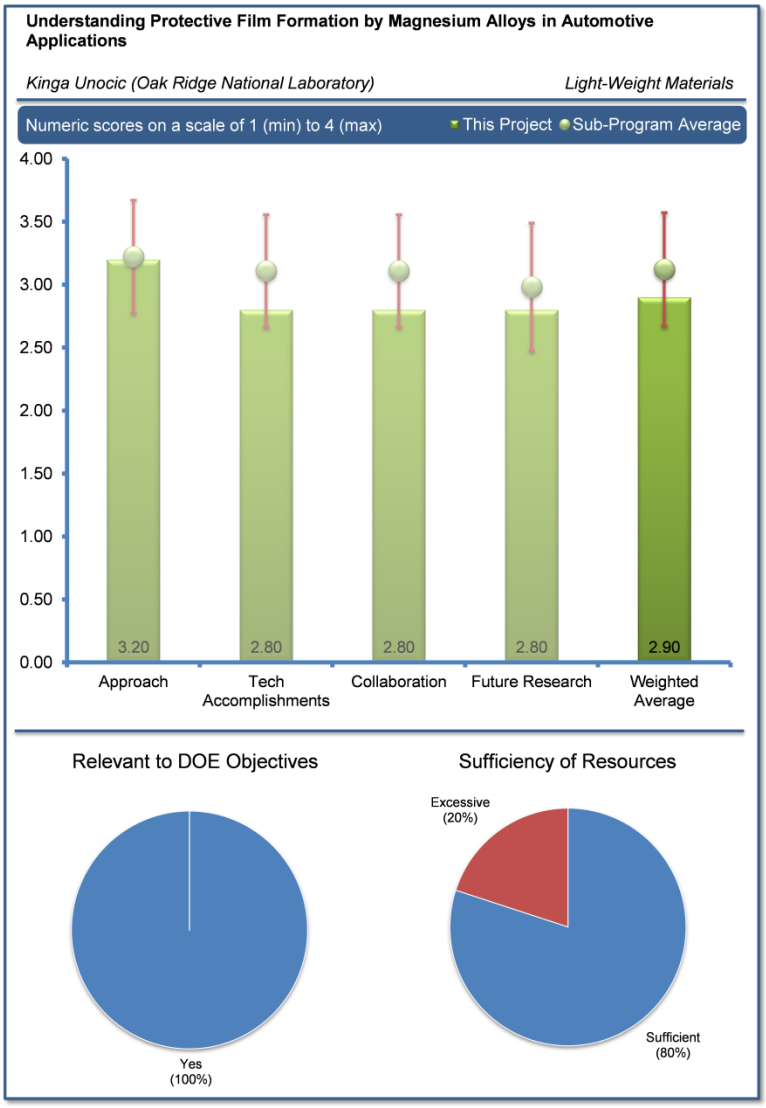
Reviewer 1:
This reviewer commented that the project was well-run and organized, hitting milestones and within budget.

Reviewer 2:
This reviewer pointed out that the money and resources appear sufficient to accomplish the project deliverables. With the demonstrated progress so far, there is confidence that the project is appropriately resourced.

Reviewer 3:
This reviewer observed no problems.

Reviewer 4:
This reviewer remarked that the match is growing, which implies that the project team underspecified the budget.

Understanding Protective Film Formation by Magnesium Alloys in Automotive Applications: Kinga Unocic (Oak Ridge National Laboratory) - lm076



Reviewer Sample Size

A total of five reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer commented that the project had very detailed work to identify corrosion mechanisms in Mg. A little too focused on micro-details, but excellent work. The reviewer added that the project team needs to expand the area of characterization and look at the micro-phases and grain boundaries to understand the microcell corrosion. The reviewer went on to say that industry has a good handle on bulk materials corrosion, so to get into impedance spectroscopy, supplement the focused ion beam (FIB) and transmission electron microscope (TEM) studies, and continue to help us understand Mg corrosion as a function of impurities.

Reviewer 2:

This reviewer said that the corrosion film formation on Mg was analyzed. It will be useful to start the database with the bare unexposed Mg surface. The reviewer added that this was not mentioned in the presentation. Also, comparing the film formation in Al will be beneficial.

Reviewer 3:

This reviewer stated that the approach lacks an idea and vision. The reviewer queried where the project is going.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer pointed out that the project team had excellent results and should consider expanding into impedance microscopy type analysis. The reviewer recommended not deviating from the current work, but focus on expanding characterization techniques. The reviewer also stated that the project team should consider Auger electron spectroscopy in addition to X-ray photoelectron spectroscopy (XPS).

Reviewer 2:

This reviewer noted that the project team has used multiple techniques to assess the surface film. The reviewer added that the project is quite elaborate and the information will provide understanding on the corrosion mechanism of Mg alloys. In addition the reviewer

said that the results are quite significant considering the project is only in initial stages; however, the interpretation needs to be more rigorous.

The following discussion is in reference to Slide 18. The reviewer noted that the top layer consists of magnesium oxide (MgO) and magnesium hydroxide ($MgOH_2$); this means the Mg is moving outwards from the metal surface as no Al or zinc (Zn) is detected here. The second layer is mixed with Al and Mg but no Zn. The reviewer questioned whether Zn diffuses inward as the corrosion process is progressing.

The reviewer stated it will be nice to see a non-corroded surface to compare the mechanism.

Reviewer 3:
This reviewer inquired about the reason for neodymium (Nd) segregation, and asked if this could be modeled. The reviewer also asked if models could be developed that could guide future development of Mg conversion coatings.

Reviewer 4:
This reviewer observed that it is early in the project, but results are minimal.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer commented that the collaboration was good, and that the project team should continue to solicit input from industry on what corrosion studies need to be undertaken and ultimately completed.

Reviewer 2:
This reviewer said that a material supplier is involved; for the basic research not many industrial partners are involved. The reviewer added that it may be useful to involve coating developers who may be interested to understand the mechanisms.

Reviewer 3:
This reviewer observed that the collaboration group is too small (ORNL and Magnesium Electron North America [MENA]).

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer noted that continuing the current work is good. The reviewer said if bare Mg surfaces and some coated surfaces are included in the analysis, it will be useful for comparison purposes.

Reviewer 2:
This reviewer said that mechanistic understanding through modeling would be helpful. The reviewer added that the complex processes in this research are fertile ground for future research.

Reviewer 3:
This reviewer indicated that the project team needs to include a baseline of Al alloy and high pressure die cast (HPDC) Mg alloys (AZ91 and AM60) to understand the Al oxide film formation and effect of HPDC surface skin.

Reviewer 4:
The reviewer would like to see more baseline data on grain (matrix) corrosion, GAB corrosion, and then bulk materials corrosion. The reviewer stated that the project team should provide more information on starting grain size (GS), rolling direction and micro-alloy segregation, and the effects on MgO formation and corrosion.

Reviewer 5:
This reviewer commented that the goals and objectives were insignificant.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer commented that although indirect, this project allows a better understanding of corrosion, and thus find corrosion mitigation solutions that would enable more Mg materials application.

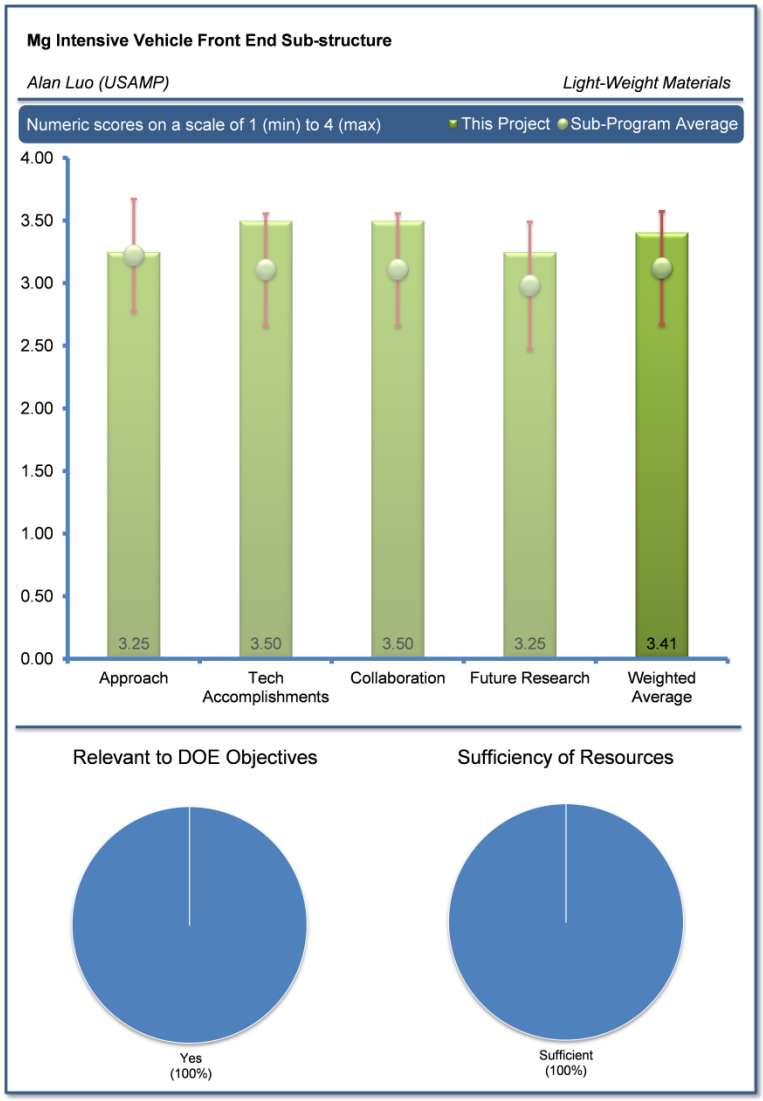
Reviewer 2:
This reviewer noted that Mg corrosion is an important issue to be resolved before it can be used extensively in vehicles.

Reviewer 3:
This reviewer stated that corrosion is a key roadblock for Mg applications.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer indicated that, for this level of detailed academic type of research, compared to other projects where tools are made, processes are developed, etc., this seems excessive for using existing characterization tools available.

Mg Intensive Vehicle Front End Sub-structure: Alan Luo (USAMP) - lm077



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer commented on the multi-material demo work, outstanding R&D plan, and very good comparison between high performance 6082 Al alloy and Mg alloy.

Reviewer 2:

This reviewer remarked that the project team has a good approach, but needs to show more focus on corrosion of joints and joining methods, such as the integration of International Computational Material Engineering (ICME) and use of demonstration component as a validation of ICME.

Reviewer 3:

This reviewer stated that while the overall approach is good, the linkages between different experimental and modeling efforts were not clear from the presentation.

Reviewer 4:

This reviewer noted that the tasks in creating a demo structure are fairly straightforward, and are well within the team's skill set. The reviewer would expect that some technical barriers will crop up, but the team seems aware of these and capable of overcoming them (maybe with some costly solutions if needed). The reviewer pointed out that critical issues for performance and life are being considered, including in the design of testing. In addition, the corrosion issues might need to be considered more carefully. The reviewer indicated that the joining issues are being considered, but no complete solution has been found. The reviewer stated that the long-term performance of these joints will be critical and is part of the project. The reviewer observed that the previous U.S. Automotive Materials Partnership (USAMP) projects (including many of the same partners) that have led to this project seem to have laid the necessary groundwork.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer noted that the project seems to be ahead in the R&D plan and on target with budget.

Reviewer 2:

This reviewer said that as shown, the initial design is completed, and some of the coupon tests have been started.

Reviewer 3:
This reviewer indicated that some progress has been made, but mostly preliminary work. The reviewer added that this might just be a matter of careful planning that was being performed that shows little advancement of the goals for the amount of time spent, but will lead to large benefits as the project progresses. The reviewer said the actual joining process and methods still need to be solved this coming year.

Reviewer 4:
This reviewer stated that the project team needs to focus on corrosion of joints.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer noted that there was outstanding team and good international collaboration.

Reviewer 2:
This reviewer remarked that the team has long-term experience working together, and already has produced some parts for initial coupon testing.

Reviewer 3:
This reviewer commented that there was a large amount of partners, from OEMs to supply base to universities. This reviewer stated that the project team should be able to leverage partnerships in order to complete the scope, especially as there seems to be some scope growth.

Reviewer 4:
This reviewer said that there is an expansive collaboration listed, but the level of interactions was not well expressed.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
The reviewer pointed out that this project builds nicely on prior work and seems reasonable to complete. The reviewer said that an additional future work question that could be considered would be determining if there is any variation between suppliers, and if that will impact production.

Reviewer 2:
This reviewer noted that the proposed work for the coming year seems to be well-defined and appropriate; focusing on the coupon tests, joining issues, and fatigue. The reviewer said the ICME portion might be taking on too much, but would greatly benefit the overall goals of DOE. The reviewer stated that no specific decision points were presented, but some possible course corrections were given for the most likely problems.

The reviewer observed that the presenter seems to imply that new materials will be introduced. This reviewer warned that caution is required because dispersion implies shallowness.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer said absolutely.

Reviewer 2:

This reviewer remarked that if the corrosion and multi-material challenges can be dealt with in a cost-effective way, this approach seems reasonable.

Reviewer 3:

This reviewer stated that the project is a practical step in the right direction to incorporation of multi-material structures into cars for lightweighting.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:

This reviewer indicated that the group seems to reach out to whoever is needed to answer relevant questions and has a broad contact base.

Reviewer 2:

This reviewer observed that, for the actual goals, the resources seem fine, but the ICME portion might eat some of the resources if not approached carefully.

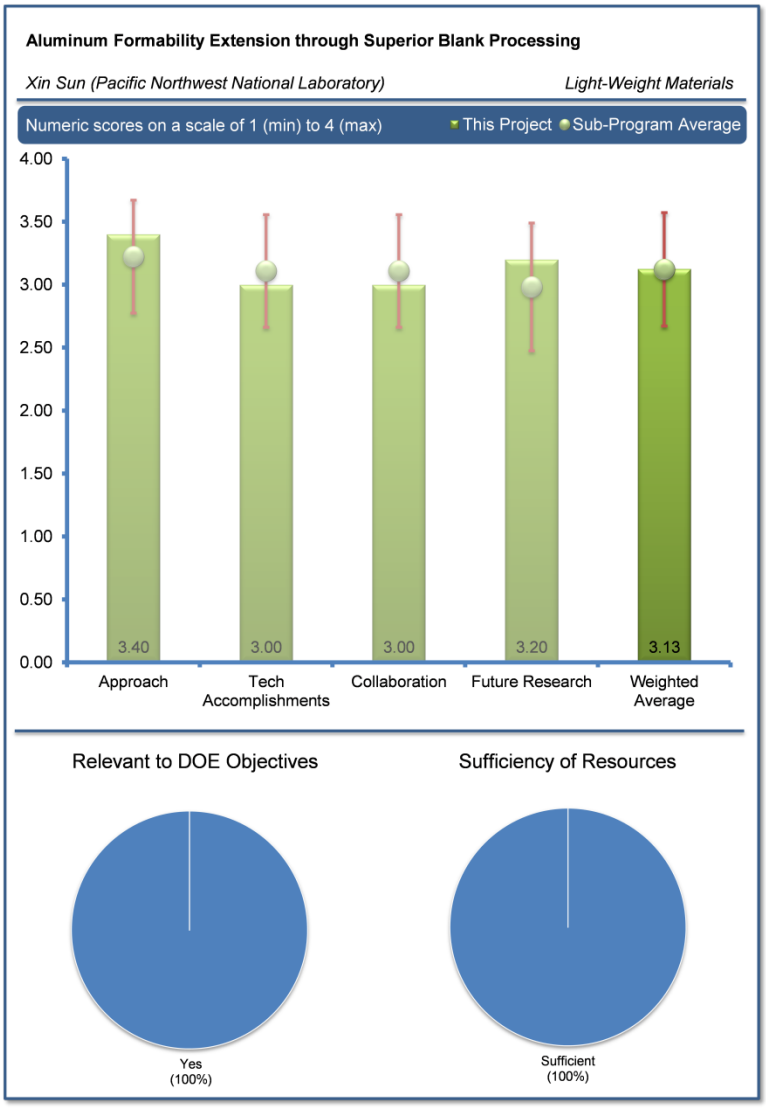
Reviewer 3:

This reviewer has no complaint.

Reviewer 4:

This reviewer said that if the partnerships are leveraged appropriately that the project team should be able to accomplish milestones in a timely fashion. The reviewer would like to see how the partnerships are leveraged. The reviewer inquired as to who is contributing to what.

Aluminum Formability Extension through Superior Blank Processing: Xin Sun (Pacific Northwest National Laboratory) - lm078



Reviewer Sample Size

A total of five reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer observed that this was an excellent project and important for the manufacturing of Al.

Reviewer 2:

This reviewer noted that the project seems generally okay, but the reviewer would have appreciated an insight into the eventual applications of this work. The reviewer said that perhaps the level of the talk was pitched at too detailed a level for this review, but it may be that the reviewer was missing the point.

Reviewer 3:

This reviewer stated that the overall project seems okay and the modeling approach was clear, but the approach to integrate the modeling results to the experimental techniques was not very clear.

Reviewer 4:

This reviewer indicated that it was unfortunate that the details of how the geometry of the burr is being input into the model. The reviewer clarified that much of the technical details are not being presented.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer indicated that there seems to be good technical progress to date (the presenter stated that project is ahead of schedule).

Reviewer 2:

This reviewer stated that the project was ahead of schedule and very detailed as far as results.

Reviewer 3:

This reviewer stated that there appears to be very positive patentable results. The reviewer added that this project should be a CRADA or Work for Others due to the content being proprietary information.

Reviewer 4:
This reviewer stated that the modeling efforts seem well integrated, but the reviewer has concerns that the resolution of the models may not be able to match the scale and complexity of the fracture surfaces.

Reviewer 5:
This reviewer stated it was difficult to assess the universality of the results and insights due to the lack of detail in the scientific process of putting the damage details into the model.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer said that it seems okay, but silo-ed.

Reviewer 2:
This reviewer indicated that collaboration is good, but it is regrettable that Ford is putting a lid on the results. The reviewer observed that, after all, a good part of the funding is done through public funding.

Reviewer 3:
This reviewer indicated that PNNL seems to be driving the efforts, but it did not feel like Oakland University and Ford were full partners.

Reviewer 4:
This reviewer said it seems okay. The reviewer added that the speaker kept alluding to other aspects of the progress but then did not discuss them, which was a bit tiresome.

Reviewer 5:
This reviewer said that the project appears to be a DOE subsidized research project.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer stated that the project team is treating the important issues, but patent issues are getting in the way of doing a proper assessment.

Reviewer 2:
This reviewer stated that proposed future research was okay, but more emphasis on the eventual commercialization plan would have been worthwhile.

Reviewer 3:
This reviewer indicated that the future research seems well in line with the research that has been completed, but the details were not very explicit due to intellectual property (IP) concerns.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer observed that the link to petroleum displacement was not very explicit. The reviewer assumed the enhanced elongation will allow greater use, but this was not made clear to what degree.

Reviewer 2:
The reviewer noted there was a good analysis of a ubiquitous process.

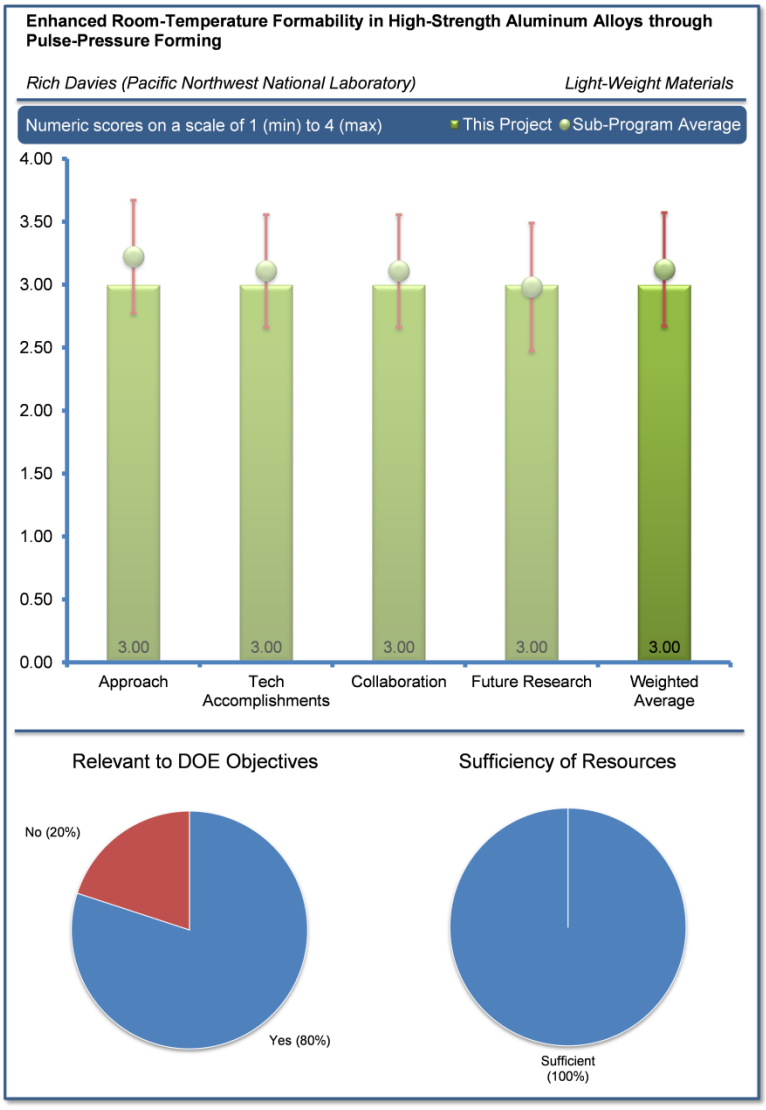
Reviewer 3:
This reviewer said yes, no doubt about that.

Reviewer 4:
This reviewer said absolutely.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer stated that there were no issues reported or observed.

Enhanced Room-Temperature Formability in High-Strength Aluminum Alloys through Pulse-Pressure Forming: Rich Davies (Pacific Northwest National Laboratory) - lm079



Reviewer Sample Size

A total of five reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer indicated that the project approach was very explicitly described and seems to line up with technical barriers.

Reviewer 2:

This reviewer noted that barriers have been identified, which is obviously important, but solutions to some of these barriers remain to be conquered. The reviewer stated that overall, the project appears to be using a good approach and making progress. The reviewer did not understand the reason for using a pre-forming approach. The reviewer doubted that a real part would ever use that method because of the poor control over final part geometry, and wondered if a more realistic approach would be to use a real die.

Reviewer 3:

This reviewer indicated that pulse pressure forming using the dome test is interesting, but research to develop an understanding of high strain rate formability enhancement does not appear to have a real world application.

Reviewer 4:

This reviewer stated that this seems to be a proof of concept project, and it is not clear what the path is other than commercializing this form of pulse forming.

Reviewer 5:

This reviewer stated that there is a considerable amount of work in this field at some OEMs. This reviewer noted that this project is not about poor formability as much as an opportunity to enhance the formability of the high-strength (HS) Al alloys. The reviewer indicated that the project remains focused on formability analysis rather than process development. The reviewer stated the limiting factor in pulse pressure forming is the cost of the process and this is a much better project direction than to develop the formability studies.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:
This reviewer said good progress.

Reviewer 2:
This reviewer said looks good, but some issues remain to be dealt with.

Reviewer 3:
This reviewer said with regard to the objectives, the project has focused on developing formability charts, but these already exist within some OEM's, for high strain rate formability. The reviewer advised the project team consider re-focusing future research on process development.

Reviewer 4:
This reviewer stated that alloy selection and process determination have been made, but it seems like most of the equipment seemed to be in place, so these seem like pretty modest goals.

Reviewer 5:
This reviewer stated that accomplishments are limited so far. This reviewer added that experimental setup is good, but nothing spectacular, and the project seems to be an assemblage of commercial off-the-shelf stuff.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer noted that the project had good engagement of selected OEMs that will learn from PNNL the limits of this process.

Reviewer 2:
This reviewer stated that the OEM, DOE Lab and material supplier are a well-rounded project team.

Reviewer 3:
This reviewer observed that the project seems okay; GM appears to be guiding the work effectively although some more words about the path to market would be helpful.

Reviewer 4:
This reviewer commented that it seems like the group has all of the personnel needed, but the interaction between groups was not as clear.

Reviewer 5:
This reviewer stated that collaboration was not terribly well-elaborated.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer stated that this points toward a database that can enable more use of Al, but again, the process needs development more than alloy formability characterization.

Reviewer 2:
The reviewer indicated that the project team seems to have an idea of the problems and experimental artifacts that the project team needs to chase down.

Reviewer 3:
This reviewer indicated that the speaker spoke briefly about the introduction of a real die, and this reviewer looks forward to that development.

Reviewer 4:
This reviewer stated that the design of prototype will likely have a strong influence on the success of the prototype. The reviewer thinks there should be a bit more work on these details.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
The reviewer commented that this project is definitely a relevant piece of work as it will enable parts to be made out of light but strong alloys of Al.

Reviewer 2:
This reviewer noted that if it is possible to improve the forming of high strength Al, this will be useful, but the linkages could have been more explicit.

Reviewer 3:
The reviewer indicated that this project remotely enables the use of Al.

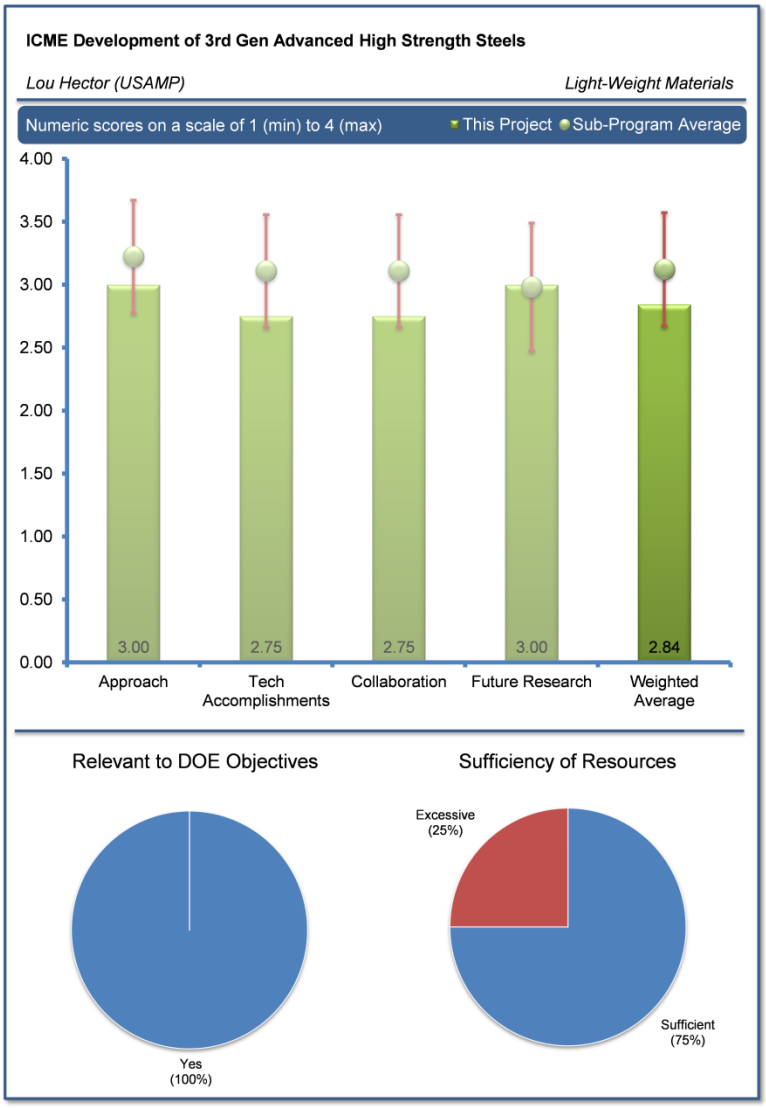
Reviewer 4:
This reviewer said that unfortunately, a potential application of this technology was not identified.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer did not observe or identify any issues.

Reviewer 2:
The reviewer commented that this project is sufficiently funded for a material characterization project, but is borderline on over funded.

ICME Development of 3rd Gen Advanced High Strength Steels: Lou Hector (USAMP) - lm080



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer stated that the project proposes a substantial and very difficult task in both meeting tough goals while simultaneously developing a fully integrated ICME process. The reviewer has doubts that the project will be fully successful, but the reviewer thinks the approach of the project is reasonable to advance the ICME field while achieving some limited success on the desired strain and strength targets. The reviewer added that the technical barriers to get the ICME models to output within 15% accuracy when the individual components are only validated to within 15% seem impossible.

Reviewer 2:

This reviewer indicated that this project was very, very complex and daunting.

Reviewer 3:

This reviewer said that the approach is not defined. The reviewer added that 19 participant groups will cause chaos.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer indicated that given nothing was expected at this point, well done.

Reviewer 2:

This reviewer commented that this project is in an early stage, too early to access accomplishments.

Reviewer 3:

This reviewer indicated that the project has just begun and that this question is not really applicable.

Reviewer 4:

This reviewer stated that as a new project, the technical accomplishment is the project plan itself and little progress is to be expected. The reviewer stated the project team does have a starting material that has been disseminated, but the next material is already in the pipeline, which might suggest the project team is doing too much at once or are just very aggressive at their task.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer said that collaboration and coordination is still being sorted out, but the pieces seem to be there.

Reviewer 2:
This reviewer noted that there are a lot of team members, and as pointed out the communication is critical. The effectiveness of the team will hinge on the necessary information being shared and used by each member. This falls on the two PIs, with little other options. This reviewer pointed out the fact that the project team has picked a material and disseminated it is positive, but the fact that a second material has already been ordered before any ICME could be performed causes the reviewer to worry that there was not real agreement on the initial material.

Reviewer 3:
This reviewer stressed that there were way too many participants, and noted 6 university groups, 11 industry groups, and 2 consortiums.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer noted that the integrated nature and design of the project is quite good, but there is a lack of decision points. This could result in continuously changing local goals on different materials. The reviewer stated that there are no cut-off points to stop individual team members from continuing to work on an abandoned material, etc., that is interesting to them alone rather than moving the overall project forward.

The reviewer commented that the upfront work is logically geared to create experimental results for validation and refinement of the various models.

The reviewer indicated that the FY 2013-2014 plan to first determine how to make the experimental heats to produce the material for ICME iteration seems sound. The reviewer stated that the starting of later task items (tasks 3-5) at this stage seems a bit premature, but could be just an attempt to front-load the effort. This could lead to later efficiencies, or be a waste if effort. The reviewer concluded that there is no way to tell at this point.

Reviewer 2:
This reviewer indicated that the vision is good, but the probability of success is zero.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer noted that the validation of the models to be used for ICME and their interaction could be enabling for future light-weighting through material design while meeting performance requirements.

Reviewer 2:
This reviewer indicated that it is not clear how much weight saving one will get by using the grades of steel. Specifically, how much additional down gauging will occur beyond what is used from current hot stamped steel.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

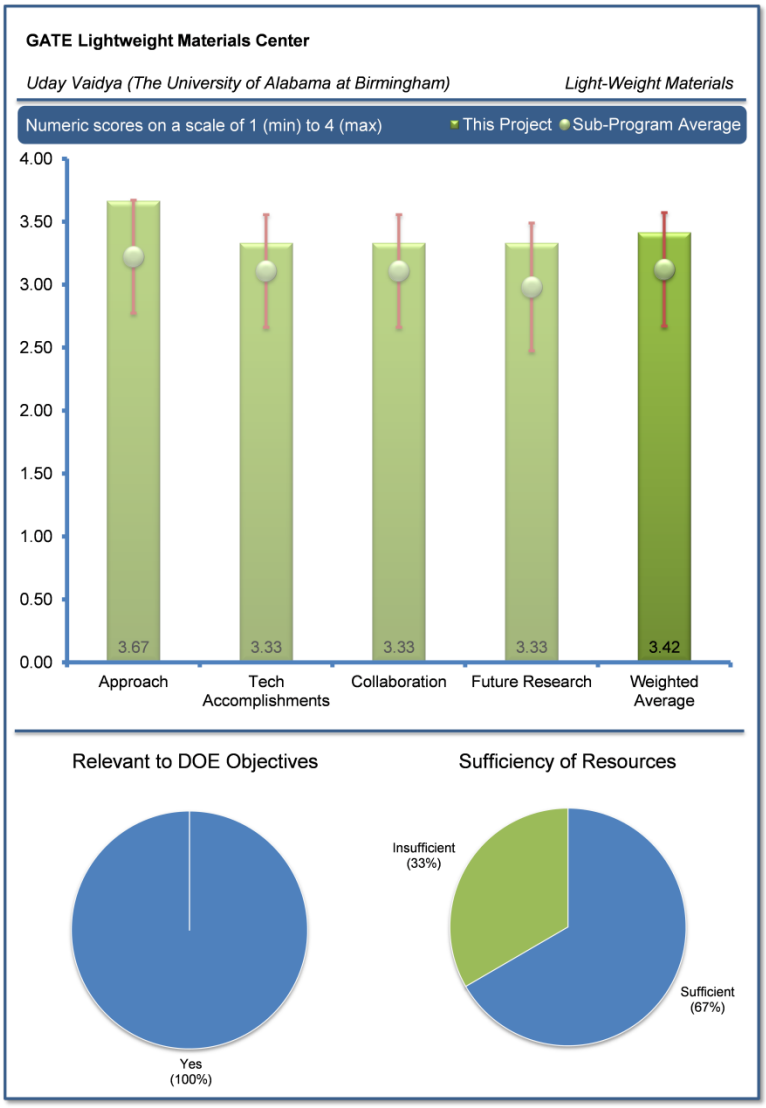
Reviewer 1:

This reviewer said the funding level is high, but the number of partners will result in spreading the funding thin. This reviewer wonders if the project is so large that the funding even with the contractor addition might not be sufficient.

Reviewer 2:

This reviewer observed there were too many participants and too few researchers.

GATE Lightweight Materials Center: Uday Vaidya (University of Alabama, Birmingham) - lm081



Reviewer Sample Size

A total of three reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

The reviewer observed that this project is a training/education effort. Involving community colleges will provide exposure to technologists on manufacturing processes.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

This reviewer said this is not a research project; training of future engineers for manufacturing industry is the objective. The reviewer added this is necessary as the manufacturing is increasingly technology-driven and proper knowledge on current technologies will increase the opportunities for the students.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

This reviewer indicated that this is a training program, and many community colleges in and around the university are included.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

No comments were received in response to this question.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:

This reviewer indicated that the education of future engineers in lightweight materials is the key to the future of the American manufacturing industry. The reviewer recommended that DOE should do more of these types of centers. The reviewer strongly emphasized that this project is a very important investment.

Reviewer 2:

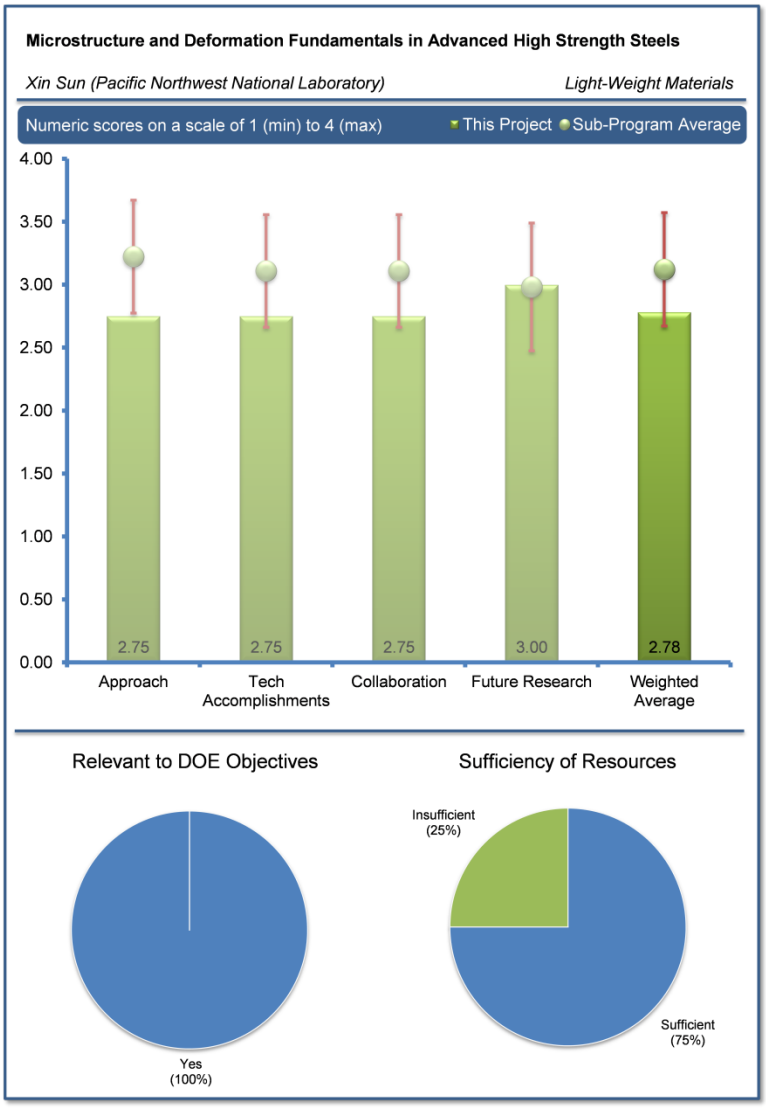
This reviewer pointed out that trained personnel are required for the North American industry to revive manufacturing. The reviewer said currently manufacturing is more technology-driven and the workers need to understand the evolving processes to succeed.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:

The reviewer observed that more funding would generate more returns, and that this project is a very efficient investment of the future.

Microstructure and Deformation Fundamentals in Advanced High Strength Steels: Xin Sun (Pacific Northwest National Laboratory) - lm082



Reviewer Sample Size

A total of four reviewers evaluated this project.

Question 1: Approach to performing the work – the degree to which technical barriers are addressed, the project is well-designed, feasible, and integrated with other efforts.

Reviewer 1:

This reviewer said very good. The reviewer indicated that DOE is right to push for such a project due to the importance of the subject for the entire industry in general and the transportation industry in particular. The reviewer went on to say that in view of this importance, DOE ought to consider several groups on the same subject and the integration of all results from all groups is more likely to produce a result that the industry will accept.

Reviewer 2:

This reviewer stated that new steels are being designed, fabricated and tested. This reviewer added the project is a good start as some existing steels under production are being used for comparison.

Reviewer 3:

This reviewer observed that the approach is only being checked against two very similar materials (mat 1 and 2), which is likely to result in any conclusions having only narrow applicability. The reviewer stated that the project team wants to do 2-3 iterations of composition-characterization-modeling, which would hopefully include a more diverse selection of material. This reviewer added that the modeling results show high sensitivity to a property the project team admits measuring to be 2.9% by one method and then 23% by another. Even if the second method is more accurate, it is very difficult to perform (requiring Advanced Photon Source [APS] beam time). The reviewer stated the method of micro-pillars compression testing is likely no good for grains of nano dimension.

Reviewer 4:

This reviewer opined that the nanoindentation of nanoscale individual embedded phases is worthless. The reviewer then asked what the project team uses as the modulus, and what is below giving a composite response.

Question 2: Technical accomplishments and progress toward overall project and DOE goals – the degree to which progress has been made, measured against performance indicators and demonstrated progress toward DOE goals.

Reviewer 1:

The reviewer stated that furnace readiness is the reason why the project is being delayed.

Reviewer 2:
This reviewer indicated the presentation could have been clearer; four new compositions are made (heat 1 to 4) and two commercial steels are used (Bao Q&P / DP). A good labeling would be beneficial; the four experimental steels are labeled as Mat 1 / Mat 2 as well as Q&P steels.

The reviewer also pointed out that the focus is on developing specific microstructures, but inquired about what would happen if further processing changes these phases. The ICME approach should address this issue as well.

Reviewer 3:
The reviewer observed that questionable data is being compared to with limited success. The reviewer said that the method of micro-pillars compression testing is likely no good for grains of nano dimension. At this stage for just two materials the reviewer would expect the project to be further along. Additionally, the reviewer indicated that the project team has not gotten through their composition-characterization-modeling cycle even one time (but claim the project is 45% complete). This reviewer stated that the project was to add quantitative understanding, but the results seem more qualitative. As mentioned above, the modeling shows a high sensitivity to phase fraction of Austenite, which is known to be hard to accurately measure, suggesting the model may never work for the intended purpose.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer stated that the academic nature of this research involves the university and the consortium of steel companies.

Reviewer 2:
The reviewer commented that this was hard to tell because there are only two partners, PNNL and Colorado School of Mines, with basically two separate tasks.

Question 4: Proposed future research – the degree to which the project has effectively planned its future work in a logical manner by incorporating appropriate decision points, considering barriers to the realization of the proposed technology, and, when sensible, mitigating risk by providing alternate development pathways.

Reviewer 1:
This reviewer said to keep it up by any means.

Reviewer 2:
This reviewer stated that no decision points were presented. The reviewer added that the plan to continue as originally planned seems a bit misguided based on the results of the Austenite measurements (either 2.9% or 23%) and the size of the grains (too small for micro pillar measurements). The plan to try more materials seems correct. According to the reviewer, the project team does not know how it will perform the formability tests, but seem to be hoping it can be done at post technology.

Reviewer 3:
This reviewer said consideration should be given to whether it is it necessary to complete all materials before the second iteration is started. The reviewer further questioned whether it is necessary to change the alloys, or whether just processing is enough for the second set of trials.

Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer noted that the development of third-generation AHSS has been identified by the steel industry as a leading way for steel to address automotive light-weighting targets.

Reviewer 2:

This reviewer stated that new steels can significantly reduce the mass of vehicles. The reviewer then asked how thin the steel parts can be made before reaching the minimum useful thickness. This will address the maximum strength required.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:

This reviewer is sure that the project could use more.

Reviewer 2:

This reviewer said that most of the work seems left to be done; even the PI claims a generous 45% complete, but there is almost no funding in FY 2014.

Acronyms and Abbreviations

Acronym	Definition
3-DEP	Three Dimensional Engineered Preform
AHSS	Advanced High Strength Steel
Al	Aluminum
AMR	Annual Merit Review
APS	Advanced Photon Source
BEV	Battery Electric Vehicle
CF	Carbon Fiber
CFD	Computational Fluid Dynamics
CFTF	Carbon Fiber Technology Facility
Cr	Chromium
CRADA	Cooperative Research and Development Agreement
DIC	Digital Image Correlation
DOE	U.S. Department of Energy
EH&S	Environmental Health and Safety
EPA	Environmental Protection Agency
EV	Electric Vehicle
FE	Fuel Economy
FEA	Finite Element Analysis
FEM	Finite Element Method
FIB	Focused Ion Beam
FOA	Funding Opportunity Announcement
FSW	Friction Stir Welding
FY	Fiscal Year
GATE	Graduate Automotive Technology Education
GM	General Motors
GS	Grain Size
HPDC	High Pressure Die Cast
HS	High-Strength
HTML	High Temperature Materials Laboratory
IAC	International Automotive Components
ICE	Internal Combustion Engine
ICME	Integrated Computational Material Engineering
INL	Idaho National Laboratory
IP	Intellectual Property
IR	Infrared
L/P	Lignin/PAN Polymer Blend Precursor
LCCF	Low-Cost Carbon Fibers

Acronym	Definition
LTT	Low Transformation Temperature
MAP	Microwave Assisted Plasma
MENA	Magnesium Electron North America
Mg	Magnesium
MgO	Magnesium Oxide
$MgOH_2$	Magnesium Hydroxide
MOxST	Metal Oxygen Separation Technologies, Inc.
MW	Molecular Weight
Nd	Neodymium
NDE	Non-Destructive Evaluation
NDT	Non-Destructive Testing
NF	Nanofiber
NHTSA	National Highway Traffic Safety Administration
Ni	Nickel
OEM	Original Equipment Manufacturer
ORNL	Oak Ridge National Laboratory
PACCAR	Commercial Vehicle Manufacturer (Kenworth, Peterbilt, DAF)
PAN	Polyacrylonitrile
PI	Principal Investigator
PNNL	Pacific Northwest National Laboratory
Q&A	Question and Answer
R&D	Research and Development
SMC	Sheet Molding Compound
SPR	Surface Plasmon Resonance
TEM	Transmission Electron Microscope
TWB	Tailor Welded Blanks
USAMP	U.S. Automotive Materials Partnership
VEHMA	Vehma International
VPSC	Viscoplastic Self-Consistent
VTO	Vehicle Technologies Office
XPS	X-ray Photoelectron Spectroscopy
Zn	Zinc