6. Lightweight Materials

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) received feedback on the overall technical subprogram areas presented during the 2014 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 responded to a series of specific questions regarding the breadth, depth, and appropriateness of that DOE Vehicles Technologies Office (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 program area, including overall strategy, adequately covered?

Question 2: Is there an appropriate balance between near- mid- and long-term research and development?

Question 3: Were important issues and challenges identified?

Question 4: Are plans identified for addressing issues and challenges?

Question 5: Was progress clearly benchmarked against the previous year?

Question 6: Are the projects in this technology area addressing the broad problems and barriers that the Vehicle Technologies Office (VTO) is trying to solve?

Question 7: Does the program area appear to be focused, well-managed, and effective in addressing VTO's needs?

Question 8: What are the key strengths and weaknesses of the projects in this program area? Do any of the projects stand out on either end of the spectrum?

Question 9: Do these projects represent novel and/or innovative ways to approach these barriers as appropriate?

Question 10: Has the program area engaged appropriate partners?

Question 11: Is the program area collaborating with them effectively?

Question 12: Are there any gaps in the portfolio for this technology area?

Question 13: Are there topics that are not being adequately addressed?

Question 14: Are there other areas that this program area should consider funding to meet overall programmatic goals?

Question 15: Can you recommend new ways to approach the barriers addressed by this program area?

Question 16: Are there any other suggestions to improve the effectiveness of this program area?

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.

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

Question 1: Was the program area, including overall strategy, adequately covered?

Reviewer 1:
The reviewer said yes. The reviewer commented that the overall program was easily understood and well presented. The business case and gaps were clearly articulated and logical in sequence.

Reviewer 2:
The reviewer said yes, and that the presentation showed a good strategy based on feedback from the industry.

Reviewer 3:
The reviewer said that the program covers the lightweighting and propulsion materials. The reviewer said that in the area of lightweighting, all the constituent materials, including aluminum (Al), magnesium (Mg), carbon fiber composites (CFCs), and steels, are well represented. The projects are addressing the identified barriers very well. The reviewer thought that similarly, the Propulsion Materials projects are developing solutions for light-duty and heavy-duty engines; the efforts on electric vehicles (EVs) is just beginning. It is expected that more material issues for EVs will be dealt with in the future as their use increases.

Reviewer 4:
The reviewer said that the Vehicle Technologies Office (VTO) program was clearly explained, the strategy was clear and consistent with the goals.

Question 2: Is there an appropriate balance between near- mid- and long-term research and development?

Reviewer 1:
The reviewer said yes, there is a good balance.

Reviewer 2:
The reviewer emphasized yes, there is a balance. The reviewer commented there is an appropriate balance between the mid-term and long-term development and research projects.

Reviewer 3:
This reviewer is impressed with that balance. Appropriately, the majority of projects and funding focus on near-term projects that are industry driven. The reviewer pointed out that there are also several basic technology development projects that may have longer term potential. For example, development of third-generation advanced high-strength steel (AHSS) appears to have a mid-/long-term potential, whereas much of the design and simulation tools have nearer term potential. The reviewer also pointed out the Graduate Automotive Technology Education (GATE) project, which focuses on education. This is clearly a longer term investment.

Reviewer 4:
The reviewer said that as more and more industry partners are involved, the projects may be moving from long-range to near- and mid-term, so a balance needs to be kept with some fundamental aspects of the materials in the portfolio.

Question 3: Were important issues and challenges identified?

Reviewer 1:
The reviewer said yes, the challenges were very well identified.

Reviewer 2:
The reviewer said that the issues/gap analysis as presented is very detailed by covering the various aspects as property requirement and performance enhancement are needed in medium- to long-term.

Reviewer 3:
The reviewer said generally speaking, yes. The propulsion materials presented gaps quantitatively with long term goals for each area. The reviewer noted that the lightweight materials (body) program identified focus areas, but did not set quantitative targets. The reviewer really liked the "When it Works" slide for the various materials. This slide summarized and brought into focus the prior slides, which explained the various considerations of lightweighting on commercial automotive.

Reviewer 4:
The reviewer commented that issues and challenges were mostly identified. The reviewer elaborated by stating that there are more broad societal issues that should be mentioned that set the framework for the technical goals and strategies. The reviewer believed that the issues of energy security and the challenges of light-duty vehicle customer expectations should have more of an airing. These help set policy and strategy.

Question 4: Are plans identified for addressing issues and challenges?

Reviewer 1:
The reviewer commented that the plans for addressing the technical issues were clearly identified.

Reviewer 2:
The reviewer said yes.

Reviewer 3:
The reviewer said yes, extensively. The reviewer commented that the currently funded programs were clearly and logically set up to tackle the stated priorities. For this reviewer, the only improvement might be building a longer term trajectory. For example, there is a shift in the composite area from low-cost carbon fiber (LCCF) funding to integrated computational materials engineering (ICME) and non-destructive evaluation (NDE) projects. According to the reviewer, this was great, but it might be a good idea to show what has been accomplished, what the current plans are intended to accomplish, and what is still to be done at some future time.

Question 5: Was progress clearly benchmarked against the previous year?

Reviewer 1:
The reviewer found that the presentations from various researchers have shown the year over year progress very clearly.

Reviewer 2:
The reviewer said yes, progress was clearly benchmarked against the previous year.

Reviewer 3:
The reviewer said that the progress highlights were presented clearly. The efforts were proceeding as expected.

Reviewer 4:
The reviewer said no, and elaborated that the accomplishments of the previous year were clearly presented. However, the reviewer observed that it was not shown how that translates into a trend or curve or measures relative to a benchmark. The reviewer noted that the accomplishments were impressive, and that the program is producing significant results.

Question 6: Are the projects in this technology area addressing the broad problems and barriers that the Vehicle Technologies Office (VTO) is trying to solve?

Reviewer 1:
The reviewer said yes. The reviewer commented that the major barriers industry is facing in the area of lightweighting are being addressed in an interesting mix of targeted technology development, such as LCCF and third-generation AHSS, and broader integrated efforts, such as the multi-material vehicle and magnesium intensive front end.

Reviewer 2:
The reviewer said yes.

Reviewer 3:
The reviewer commented that the projects address the multi-faceted issues and barriers surrounding lightweight materials and technologies.

Reviewer 4:
The reviewer observed that the energy efficiency of a vehicle is impacted by the weight and the efficiency of the powertrain. These aspects are being investigated by the subprograms on lightweighting and propulsion (internal combustion and electrification); while lightweighting is being supported very well, the support for the propulsion materials is marginally lower. The reviewer commented that lightweighting contributes to the short- and mid-term goals and the powertrain may contribute more towards long-term. The funding should reflect this aspect.

Question 7: Does the program area appear to be focused, well-managed, and effective in addressing VTO's needs?

Reviewer 1:
The reviewer said yes the program area appeared to be focused, well-managed, and effective in addressing VTO's needs.

Reviewer 2:
The reviewer found that the projects are selected to address the priority areas and are well managed.

Reviewer 3:
The reviewer concluded that the program is properly focused with efforts in many material and process systems, joining, corrosion and the computational tools that enable product and component design.

Reviewer 4:
The reviewer responded yes. The reviewer commented that the efforts are not a multitude of diluted efforts across a wide variety of potential performers, but rather focused, integrated efforts targeted at addressing a particular problem. This ensures sufficient resources are invested to address the problem and make significant progress towards a solution. The reviewer commented that it also allows course corrections in future years to address the new problems that are exposed based on the ongoing efforts.

Question 8: What are the key strengths and weaknesses of the projects in this program area? Do any of the projects stand out on either end of the spectrum?

Reviewer 1:
The reviewer said that the projects are all good.

Reviewer 2:
The reviewer found key strengths to include integrated efforts across multiple performers to address significant issues (ICME of composites, multi-material vehicles [MMV], ICME of third-generation AHSS).

A key weakness is the project that is modeling weight impacts on crashes is not moving towards success. This reviewer's comments of that project have been submitted.

Reviewer 3:
The reviewer commented that there are few projects that are just evaluating existing materials; the data which are being generated needs to be correlated to metallurgical/manufacturing variables so that the data can be used in future. The reviewer cited lm073 and pm038.

The reviewer noted, on the other hand, projects such as lm054 and lm075 are very relevant to industry and have delivered good results. The new projects on ICME based research are having a good start and need to be watched.

Reviewer 4:
The reviewer detailed as strengths the diversity of the portfolio. This reviewer is particularly interested in the high strength aluminum efforts. The reviewer identified as weaknesses end-of-life recycling, especially for CFCs.

Question 9: Do these projects represent novel and/or innovative ways to approach these barriers as appropriate?

Reviewer 1:
The reviewer responded yes.

Reviewer 2:
The reviewer commented that there is a healthy mix of evolutionary and revolutionary efforts to enhance the use of lightweight materials in automotive structures.

Reviewer 3:
The reviewer commented some yes, others no. The reviewer thinks in almost all cases the approach taken is appropriate and justified. The reviewer found that the approaches generally speaking do not have major holes, validate everything, and tackle a problem of significant importance.

Question 10: Has the program area engaged appropriate partners?

Reviewer 1:
The reviewer said yes.

Reviewer 2:
The reviewer commented that the program has successfully engaged OEMs, suppliers, universities, consultants and national laboratories, and concluded good collaboration.

Reviewer 3:
The reviewer commented that the primary partners appear to be the following: Oak Ridge National Laboratory (ORNL), with focuses on carbon fiber and propulsion simulation; Pacific Northwest National Laboratory (PNNL), with a focus on metals; USCAR/ original equipment manufacturers (OEMs), with focuses on integrated and validation projects; and some material suppliers. The advanced topics, such as breakthrough techniques in multi-material joining, are conducted by universities. The reviewer concluded that for transition purposes, these are all the right organizations. That said, the reviewer suggested it may be appropriate to look at what other technologies are being developed by other government laboratories beyond the U.S. Department of Defense (DOD) laboratories, including the National Aeronautics and Space Administration (NASA) (likely simulation), Forest Services labs (have developed a lightweight nano-fiber from wood), and DOD laboratories. The reviewer suggested that particularly in the area of composites, more coordination might be possible.

Reviewer 4:
The reviewer noted that the partnerships in the program, for both lightweight and propulsion materials, is made of many North America producers and Tier 1 suppliers; the presence of other international OEMs is not evident. The reviewer suggested that even though international OEMs may not be investing in R&D in North America, some efforts may be needed to bring them to the program.

Question 11: Is the program area collaborating with them effectively?

Reviewer 1:
The reviewer said yes.

Reviewer 2:
The reviewer said yes. The reviewer remarked that these laboratories have the specialized facilities, expertise, and industry relationships that make them natural partners for VTO.

Reviewer 3:
The reviewer said yes, and commented that there appeared to be good support, direction, monitoring, and interactions.

Reviewer 4:
The reviewer noted that while some of the industrial partners are contributing heavily through in-kind participation, the quantum of this is not consistent across all the partners/projects.

Question 12: Are there any gaps in the portfolio for this technology area?

Reviewer 1:
The reviewer said that the program needed more funding.

Reviewer 2:
The reviewer remarked that some of the barriers to adoption are not technical per se, but rather business and design process driven. The reviewer provided as an example qualifying composites has been cited as a barrier, and there have been numerous efforts across the government to address this issue. Yet, this issue still comes up, and it is not clear to this reviewer how it will be addressed in the automotive space. The reviewer asked is this not an issue for automotive, and if not, why not. If so, the reviewer would like to know what its impact is. The reviewer asked about the supply chain, and if there was adequate supply. The reviewer would like to know if the supply chain model is broken, or is industry able to handle this naturally. Technical gaps that came to mind for this reviewer are adhesives and corrosion. The MMV project should help identify the major issues that would prevent the adoption of some of the technologies that lead to a 30% weight reduction. The reviewer would like to know what areas could benefit the most from focused government investment to develop the technologies that would lead to a 50% lighter vehicle.

Reviewer 3:
The reviewer pointed out that sustainability, lifecycle assessment, and recycling needed to be integrated in the projects as new materials are being introduced. The reviewer noted that few existing projects have some of the issues covered but making it another task item will be useful.

Reviewer 4:
The reviewer commented that gaps include recycling of carbon fiber and many composite materials. The reviewer suggested that DOE can be the referee for more standardized composite material and process systems. Designers are still required to pick a raw material supplier, a sizing system, a resin system and then fabric form and part manufacturing all that influence the structural behavior of the finished part. The reviewer noted that designers need to have robust material properties, like DP600 steel or AA-6062-T4 extrusion whose material performance is rather independent of the supplier(s).

Question 13: Are there topics that are not being adequately addressed?

Reviewer 1:
The reviewer responded yes. The projects the reviewer evaluated appeared to address the topics adequately to achieve significant progress. The reviewer acknowledged that these projects will not likely solve all the problems. This is in part because it is often impossible to control for geometry and design architecture. The reviewer commented that further evaluations and projects will be necessary within the commercial community to understand the strengths and limits of the technologies. But, within the priorities and gaps outlined in the program, the topics are being adequately addressed.

Reviewer 2:
The reviewer commented low-cost composite manufacturing.

Reviewer 3:
The reviewer commented that there needs to be more attention to end of life and recycling especially for the composite areas.

Question 14: Are there other areas that this program area should consider funding to meet overall programmatic goals?

Reviewer 1:
The reviewer commented that the program is focused on supporting the needs of the existing high volume automotive industry. These companies have significant infrastructure to support and are, for the most part, tied to their particular vehicle architectures. The reviewer commented that smaller companies do not have these restrictions and could utilize alternative vehicle architectures. These new architectures might be superior in electric and fuel cell vehicles. The reviewer remarked that there appears to be no significant investment in exploring non-established vehicle architectures.

Reviewer 2:
The reviewer commented that CFCs need more funding.

Reviewer 3:
This reviewer referenced the response given in Question #2. Some fundamental aspects of materials research need to be supported; this should provide a long-term goal for the program.

Reviewer 4:
The reviewer recommended that there needs to be further efforts on end-of-life and recycling, reuse, reclamation of composites, especially CFCs.

Question 15: Can you recommend new ways to approach the barriers addressed by this program area?

Reviewer 1:
The reviewer commented that the current approach is good.

Reviewer 2:
This reviewer will have to think about this more before the reviewer can offer significant suggestions.

Reviewer 3:
The reviewer commented that the program must attack composite and CFC recycling and end-of-life. Additionally, DOE should increase efforts on manufacturing aspects, especially joining and corrosion.

Question 16: Are there any other suggestions to improve the effectiveness of this program area?

Reviewer 1:
The reviewer said that even though the scientific community is aware of past development in the area of their research, the industry/government team may not be aware of them. The reviewer commented that it will be helpful to have some experts provide state of the art/reviews. This can provide context to some of the new research themes. The reviewer provided as an example a presentation on the capability of internal combustion engines as evolved through the years will show the light for work on new high-temperature materials.

Reviewer 2:
The reviewer commented mostly good job here. This reviewer suggested focusing on fewer, larger value projects. Work on including all the aspects of a full vehicle performance, especially noise, vibration, and hardness (NVH) and heating, ventilation, and air conditioning (HVAC) requirements into the vehicle systems that are the subject of lightweight actions.

Reviewer 3:
The reviewer did not offer any suggestions to improve the materials technical area. However, this reviewer did offer a suggestion under the EV Everywhere umbrella. Similar to the way the use of EVs are tied to high-occupancy vehicle (HOV) lanes in California to encourage public purchase of EVs, linking EVs to parking benefits in Washington, DC, or other high density urban areas might have significant impact. The reviewer cited as an example that landlords who install charging stations would get some sort of tax or other

financial benefit that would have to be partially shared with the tenant through reduced parking fees for some period of time [DOE Program Note: The reviewer's suggestion has been passed to the EV Everywhere team.].

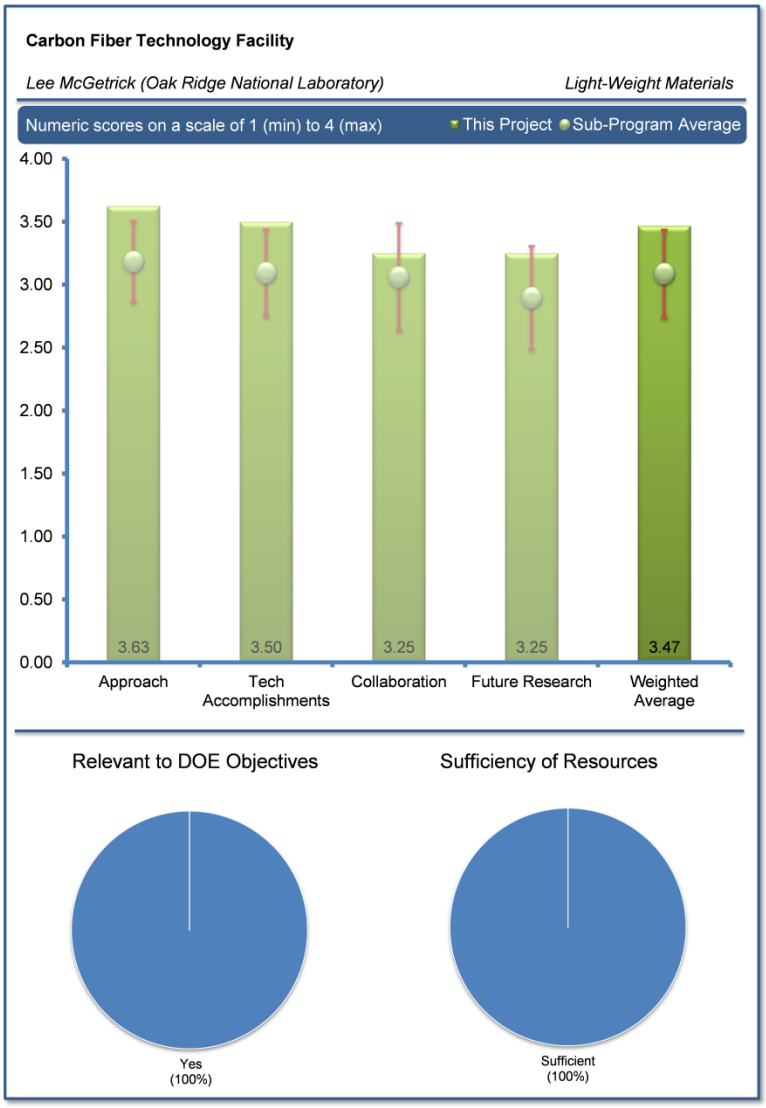
Project Feedback

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, and numeric score responses *(on a scale of 1.0 to 4.0)*. 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 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)	6-12	3.63	3.50	3.25	3.25	3.47
Advanced Oxidation & Stabilization of PAN-Based Carbon Precursor Fibers	Dave Warren (Oak Ridge National Laboratory)	6-14	3.63	3.13	3.00	3.25	3.25
Scale-Up of Magnesium Production by Fully Stabilized Zirconia Electrolysis	Steve Derezinski (MOxST)	6-16	3.25	3.50	3.63	2.88	3.38
Development and Commercialization of a Novel Low-Cost Carbon Fiber	George Husman (Zoltek)	6-19	2.75	2.50	2.88	2.88	2.66
On-Line Weld NDE with IR Thermography	Dave Warren (Oak Ridge National Laboratory)	6-21	3.50	3.20	3.00	3.00	3.23
Non-Rare Earth High-Performance Wrought Magnesium Alloys	Curt Lavender (Pacific Northwest National Laboratory)	6-24	3.13	3.63	3.00	3.00	3.34
Mechanistic-Based Ductility Prediction for Complex Mg Castings	Xin Sun (Pacific Northwest National Laboratory)	6-28	3.50	3.00	3.13	3.00	3.14
Aerodynamic Lightweight Cab Structure Components	Mark Smith (Pacific Northwest National Laboratory)	6-31	2.83	3.00	3.00	2.83	2.94
Improving Fatigue Performance of AHSS Welds	Dave Warren (Oak Ridge National Laboratory)	6-34	3.25	3.25	2.88	3.00	3.17
Relationships between Vehicle Mass, Footprint, and Societal Risk	Tom Wenzel (Lawrence Berkeley National Laboratory)	6-37	2.75	2.75	2.88	2.00	2.67
Multi-Material Lightweight Prototype Vehicle	Tim Skszek (VEHMA International of America)	6-41	3.67	3.17	3.33	3.33	3.33
Residual Stress of Bimetallic Joints and Characterization	Thomas Watkins (Oak Ridge National Laboratory)	6-44	3.00	3.33	3.00	3.00	3.17
SPR Process Simulation, Analyses, & Development for Mg Joints	Elizabeth Stephens (Pacific Northwest National Laboratory)	6-46	2.75	2.50	3.13	2.63	2.66
High Speed Joining of Dissimilar Alloy Aluminum Tailor Welded Blanks	Yuri Hovanski (Pacific Northwest National Laboratory)	6-49	3.75	3.50	3.50	3.13	3.52
Understanding Protective Film Formation by Magnesium Alloys in Automotive Applications	Kinga Unocic (Oak Ridge National Laboratory)	6-52	3.13	3.25	2.75	2.88	3.11
Magnesium-Intensive Front End Sub-Structure Development	Steve Logan (United States Automotive Materials Partnership)	6-56	3.33	3.33	3.50	3.33	3.35
Aluminum Formability Extension through Superior Blank Processing	Xin Sun (Pacific Northwest National Laboratory)	6-59	3.25	3.25	3.38	3.13	3.25

Presentation Title	Principal Investigator and Organization	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
Enhanced Room-Temperature Formability in High-Strength Aluminum Alloys through Pulse-Pressure Forming	Rich Davies (Pacific Northwest National Laboratory)	6-62	3.17	2.83	3.17	2.50	2.92
Integrated Computational Materials Engineering Approach to Development of Lightweight 3GAHSS Vehicle Assembly	Lou Hector (United States Automotive Materials Partnership)	6-65	3.38	3.25	3.63	3.38	3.34
GATE Center of Excellence at UAB for Lightweight Materials and Manufacturing for Automotive, Truck and Mass Transit	Uday Vaidya (University of Alabama at Birmingham)	6-69	3.13	3.13	3.25	2.13	3.02
Development of 3rd Generation Advanced High Strength Steels (AHSS) with an Integrated Experimental and Simulation Approach	Xin Sun (Pacific Northwest National Laboratory)	6-73	2.50	2.17	1.83	1.83	2.17
Predictive Engineering Tools for Injection-Molded Long-Carbon-Fiber Composites	Ba Nghiep Nguyen (Pacific Northwest National Laboratory)	6-76	2.88	2.88	3.25	3.00	2.94
Validation of Material Models for Automotive Carbon Fiber Composite Structures	Libby Berger (General Motors LLC)	6-78	3.25	3.25	3.25	3.13	3.23
Collision Welding of Dissimilar Materials by Vaporizing Foil Actuator	Glenn Daehn (Ohio State University)	6-81	3.25	3.25	3.13	3.38	3.25
Active, Tailorable Adhesives for Dissimilar Material Bonding, Repair and Assembly	Mahmood Haq (Michigan State University)	6-84	3.00	2.88	1.88	2.63	2.75
Overall Average			**3.19**	**3.10**	**3.07**	**2.90**	**3.09**

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 is an ambitious effort, but significant progress is being made. The reviewer said that the project team is learning that some of the industry assumptions may no longer be valid and they are breaking new ground.

Reviewer 2:

The reviewer commented that the approach laid out by the leadership of the Carbon Fiber Technology Facility (CFTF) has established the facility as a national resource and the CFTF continues to reach out to organizations to solicit additional collaborators, as well as workforce development.

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 accomplishments of getting this facility up and running are impressive. The reviewer added that the education component is also working well.

Reviewer 2:

The reviewer observed that the output of the CFTF has exceeded the performance targets (250 kips per square inch (ksi)/25 mega pounds per square inch [Mpsi]) initially set by the program and have reached levels of 500ksi tensile strength and 35ksi modulus. The reviewer added that the project team's focus on the textile pan will help improve the cost position of the carbon fiber, but more work needs to be done.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer stated that the Oak Ridge National Laboratory (ORNL) has a significant list of industrial and academic collaborators utilizing the carbon fiber (CF) product produced on the CFTF line. The reviewer added that while running at only 60% capacity, more opportunities for additional collaboration may help accelerate adoption into the marketplace.

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 improving efficiency, expanding industrial partnerships and scaling up other technologies (e.g., plasma surface treatment) are outlined in the proposed future activity section and are all solid ideas. The reviewer noted that the displays at the end of the CFTF line are of great value to visiting engineers. The reviewer added that actual parts from actual production applications allow engineers and scientists the opportunity to think about the possibilities that carbon fiber composites (CFCs) can bring to industry.

Reviewer 2:
The reviewer stated that the project team is proposing to tackle key problems in the industry that will advance the entire composites field.

Reviewer 3:
The reviewer remarked that it seems the bulk of the of proposed future research focuses on efficiency improvements, productivity improvements, and expansion of industry partnership. The reviewer added that it would be valuable to demonstrate a better clarity on the degree at which such initiatives would influence long-term impact of the center for meeting original project goal objectives.

Reviewer 4:
This reviewer did not hear a list of research ideas.

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

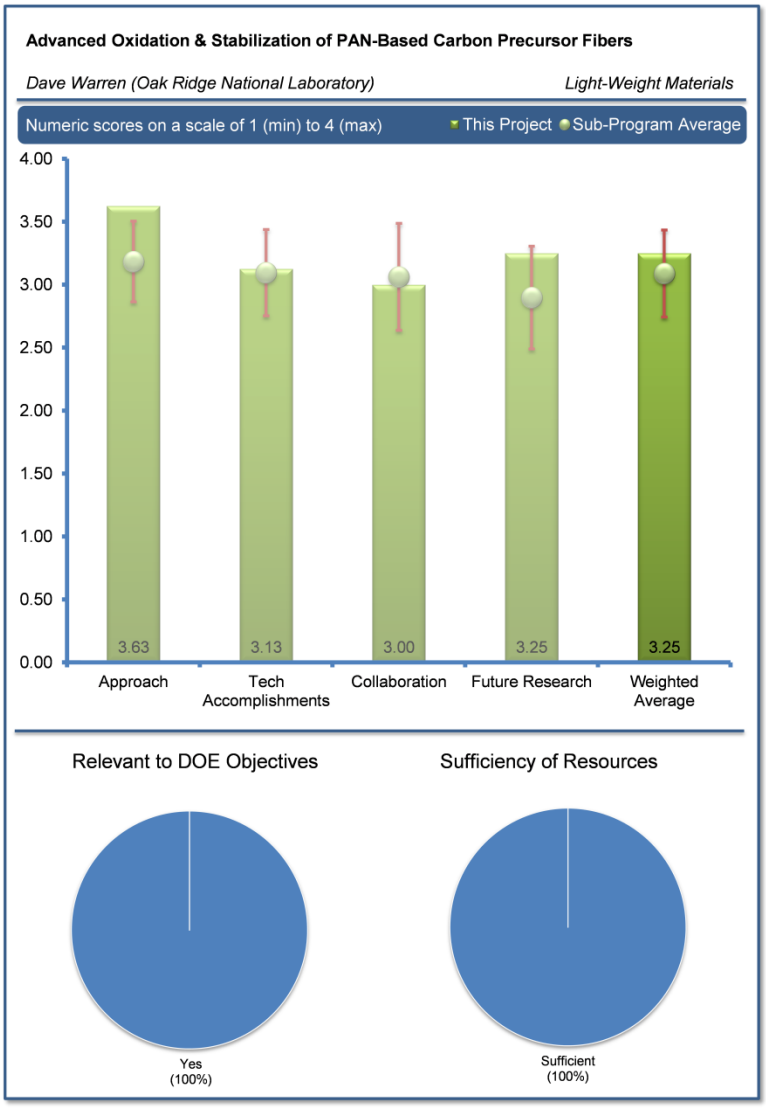
Reviewer 1:
This reviewer commented that having such facility is absolutely critical in achieving long-term DOE objectives.

Reviewer 2:
The reviewer said that low cost CF has many implications in transportation, wind energy, natural gas, etc.

Reviewer 3:
The reviewer stated that CFCs are key material technologies that will bring lightweight solutions to the automotive industry to help original equipment manufacturers (OEMs) meet current and future fuel economy and greenhouse gas emission standards.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
No comments were received in response to this question.

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:

The reviewer stated that this project addresses some key issues in manufacturing CF that have wide ranging implications. This manufacturing improves the efficiency and speed of the process. The reviewer added that the lower temperatures used in oxidation can allow for changes in the precursor that have yet to be explored. This could be extended to the other low cost precursor programs and combine for even larger savings.

Reviewer 2:

This reviewer commented that the approach of using plasma instead of diffusion for oxidation of the precursor fibers is a solid approach towards decreasing the cost of CF by addressing 18% of the cost equation. The reviewer added that a four-zone reactor will help address the variability and lower properties exhibited as compared to the diffusion oxidation fibers.

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 said that the project team has exceeded the performance targets thus far and it seems that further improvements will be possible.

Reviewer 2:

The reviewer commented that the small reactor resulted in fibers with lower properties than conventional fibers; however, a significant reduction in cycle time was exhibited (2-3X). The scale up of the four-zone reactor should help with physical properties.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer pointed out that this technology could be further extended to other programs.

Reviewer 2:
The reviewer stated that ORNL is collaborating exclusively with RMX Technologies, who will execute an option to exclusively license. Several companies have expressed interest.

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 commented that the current work on the large reactor should continue. The reviewer added that scaling up a plasma oxidation oven for an advanced technology/demonstration line in the CFTF would be valuable.

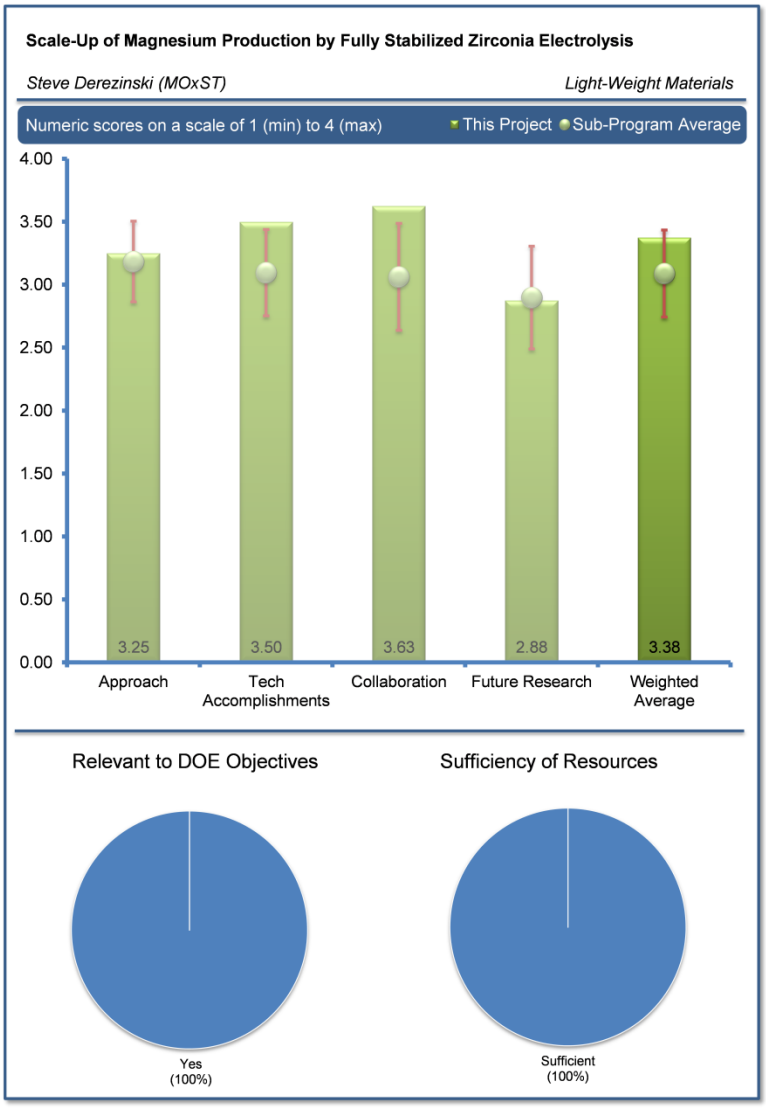
Question 5: Does this project support the overall DOE objectives of petroleum displacement? Why or why not?

Reviewer 1:
This reviewer remarked that lowering the manufacturing cost of CF and maintaining properties has implications in lightweighting vehicles and also wind energy.

Reviewer 2:
This reviewer commented that research to reduce the cost of CF should continue. The reviewer added that low cost CFCs are needed in the transportation industries to address current and future fuel economy and greenhouse gas emission regulations.

Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
No comments were received in response to this question.

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



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 said that the overall approach appears to be well designed and likely to produce good results for the project. The reviewer placed a strong emphasis on applying the study data to the production of real world vehicle components and so more of that type of data is always welcome.

Reviewer 2:

The reviewer asked if the anode lifetime is the rate-limiting step for this process. The reviewer also asked if there is any theoretical modeling going on to support design enhancements to the current version of the instrumentation.

Reviewer 3:

The reviewer stated that the approach as originally planned is being kept but the timeline is being extended. The reviewer added that even though there is no additional cost to the U.S. Department of Energy (DOE) the time for the return on investment (ROI) is being prolonged.

Reviewer 4:

The reviewer commented that the project team should hurry up and deliver a scaled production process, there are many opportunities for magnesium (Mg) in automotive and we need a domestic source of basic ultra high purity (UHP) Mg.

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 remarked that this is a tough technical project and it appears that barriers are being steadily addressed and overcome. Well done.

Reviewer 2:

The science put into the anode development and the process development is sound, structured and on target based on the original Funding Opportunity Announcement (FOA). All targets are being met and the project must continue.

Reviewer 3:
This reviewer pointed out that Alpha 3.0 shows promise. The reviewer asked how much material can be made from this technique upon scale-up. The reviewer also asked if the proposed approach to Mg manufacturing could match existing manufacturing approaches in size and cost.

Reviewer 4:
The reviewer stated that the progress is incremental from the previous year; it is difficult to estimate the level of progress because the timeline is being extended. The reviewer added that technical accomplishment in the electrolysis is dependent on the life of the anodes. The life of the anodes is being evaluated now. The reviewer stated that it would be useful to know what specifications were used on the life of material for the other electrolysis process. The reviewer also added that enough Mg would have been produced through the alpha and beta cells; the quality of pure Mg from the impurity stand point is not presented.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that all collaborators are excellent choices, and the reviewer is looking forward to the developments with Spartan and Magna/Vehma to make actual automotive parts.

Reviewer 2:
The reviewer remarked that there were many collaborators developing enabling technologies. The reviewer added that it is nice to know as the new technology is evolving the project team is looking after the various needs such as gas recycling and anode material suppliers.

Reviewer 3:
The reviewer commented that seven industrial partners were noted from this presentation. The Principle Investigator (PI) is communicating with these partners and appeared to be listening to their recommendations.

Reviewer 4:
The reviewer said that collaboration appears to be strong, well organized and effective.

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 continue the great work.

Reviewer 2:
The reviewer stated that the only tangible work to be carried out will be the long term durability of the electrodes. The reviewer added that the testing of Mg on parts is mostly carried out by partners but the project produces only pure Mg, which does not need lots of testing.

Reviewer 3:
The reviewer asked if there is any chance that Mg alloys can be produced with this technique that do not corrode (or at least corrode far less than existing alloys). The reviewer also asked what range of alloys can be produced with this technique. The reviewer asked if this technique would produce wrought Mg alloys (following subsequent processing) that are more formable that existing Mg alloys available commercially. The reviewer asked what advantages this technique offers to end users such as the automotive industry. The reviewer also asked if it will only be cost reduction compared with existing alloys, or will more formable alloys become available. The reviewer also asked what about greenhouse gas emissions. The reviewer asked if measures to reduce greenhouse gases will add much cost to this process upon scale-up. The reviewer asked, assuming that this process is successful, if this process will be able to keep up with demands based upon current outputs from the traditional Mg manufacturing base.

Reviewer 4:
The reviewer aid that the project overall, was quite good but the reviewer would have appreciated somewhat more detail on where this project is headed next.

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 seems to be fully aligned with DOE goals for lightweighting of future vehicles because it deals directly with the production of large scale amounts of Mg for commercial use.

Reviewer 2:
The reviewer noted the need for lower cost and domestic sources for Mg to enable all Mg alloy development.

Reviewer 3:
The reviewer asked if this process could be integrated into a hot rolling step. The reviewer then inquired that perhaps this is a dumb question, but in the end, how is the material produced with this technique to be processed into sheet, plate, extrusions, etc.

Reviewer 4:
The reviewer remarked that even though the project is not directly feeding to the objective, it is aimed to increase the availability of Mg from a U.S. supplier.

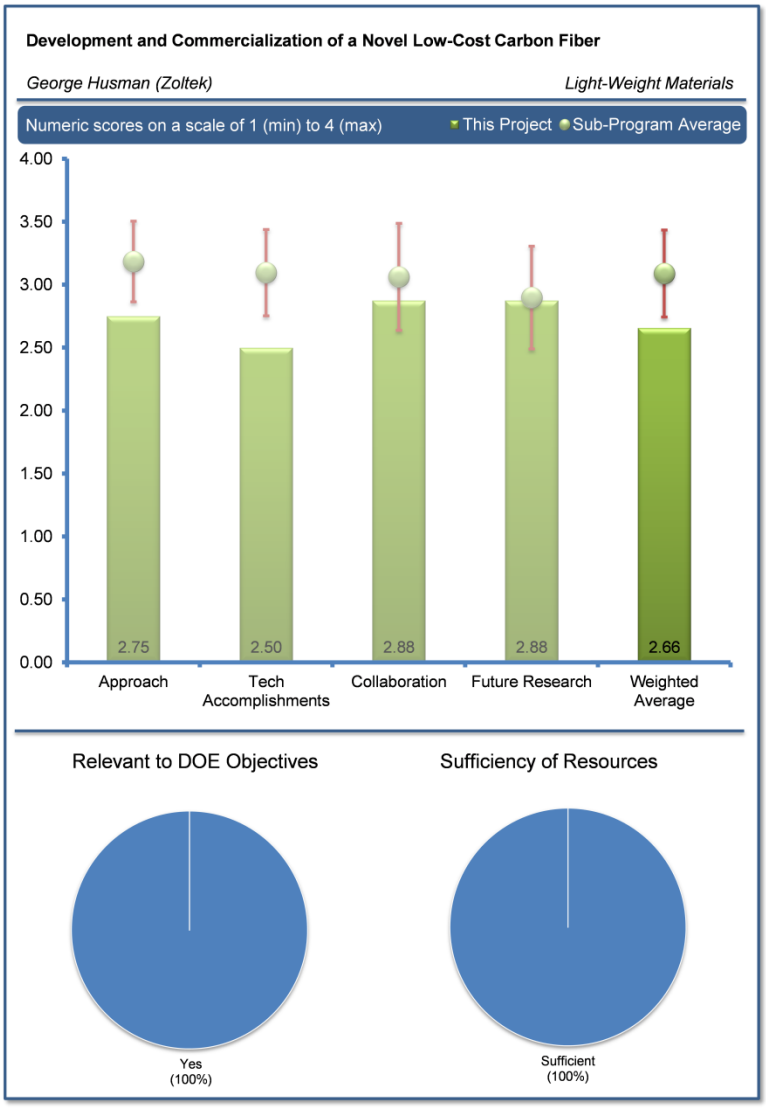
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
This reviewer remarked that the project seems to be a bit thin on resources. The reviewer then asked if there is a shortage of personnel.

Reviewer 2:
This reviewer stated that the resources appear to be adequate.

Reviewer 3:
This reviewer said that the project was appropriately resourced.

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 this effort can lower the cost of CF and essentially be a drop into existing manufacturing processes. This makes it more likely to be achievable in the short term. The reviewer added that other projects may have larger overall cost savings, but these are significant and implementable. Also, the reviewer said that other programs can also be combined with this effort to achieve even larger savings.

Reviewer 2:

The reviewer remarked that the approach of combining lignin with polyacrylonitrile (PAN) is acceptable. The reviewer added that the plan to evaluate high molecular weight PAN and evaluating it while blended with lignin to determine a go/no go decision is warranted.

Reviewer 3:

The reviewer commented that mixing lignin with PAN is not innovative. The reviewer added that the project team should look at how to disperse lignin at the molecular level and avoid phase separation.

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 commented that it seems there are still some hurdles to overcome, but significant progress was made.

Reviewer 2:

The reviewer said that as outlined in the presentation, this project has undergone some challenges in compatibility during the process. Only precursor containing 25% lignin made it through carbonization. Physical properties were lower than traditional PAN based composite (61.2 versus 47.9 ksi flexural strength; 4.06 versus 3.74 msi flexural modulus). The reviewer then asked what additional work the project team is doing to understand the chemistry of oxidation.

Reviewer 3:

This reviewer said that the data showed poor properties.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer suggested that it may be a bit more difficult since Zoltek is now owned by Toray; however, it seems this could be better connected with other programs on low cost CF manufacturing for additional benefits. The reviewer added that at the same time this effort is well focused and practical so some of that collaboration should occur after this has been commercialized. The reviewer then asked how the lignin containing fibers would work in the plasma process being developed at ORNL.

Reviewer 2:
The reviewer said that it is unclear as to whether sufficient brain power is working on this project to fully understand the science/chemistry. The reviewer suggested that outside consultants or laboratories may be of value.

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 remarked that the plan for future work is sufficient to quantify the findings of the pilot scale optimization and equipment modifications. The reviewer is looking forward to more positive technical results in the coming year.

Reviewer 2:
The reviewer commented that the path forward to accomplish reasonable properties was not clear.

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

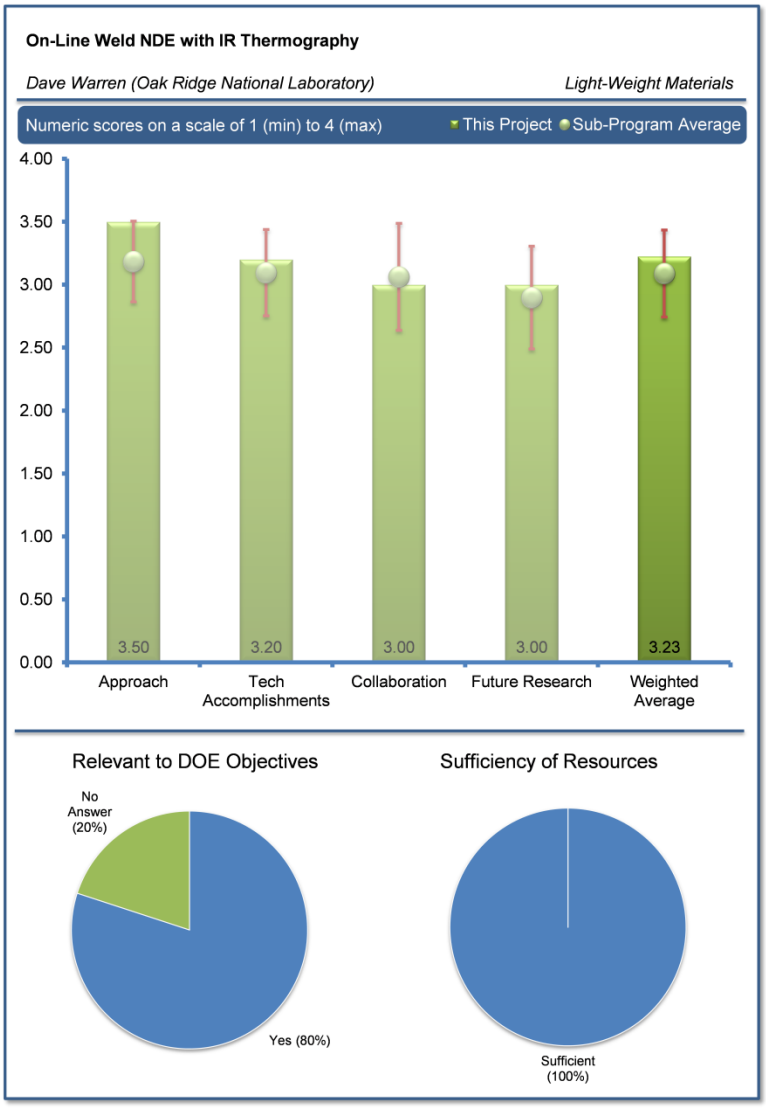
Reviewer 1:
The reviewer stated that this project aims to reduce the cost of CFCs by addressing the cost of the precursor. The reviewer added that lightweight CFCs will help car companies build lightweight applications in order to meet current and future fuel economy and greenhouse gas emission regulations.

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

Reviewer 1:
This reviewer pointed out that the significant cost sharing by the industrial partners seems appropriate.

Reviewer 2:
This reviewer stated that as outlined previously, the team may have sufficient resources to execute on the work plan, but the project team may want to consider additional scientists to understand the chemistry of the lignin/PAN oxidation reactions.

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



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 has addressed the shortfall as identified in the proposal very well. The approach is good and has produced reliable results overcoming the barrier cited as the reason for the project.

Reviewer 2:

The reviewer remarked that it would help to have some quantitative definition of what is meant by "weld quality." The reviewer then asked if this is based upon measurements or observations from weld surfaces. Alternatively, the reviewer asked what information can be provided about the state of the weld interior. The reviewer then asked what is meant by measuring the thermal response of the weld. The reviewer asked can the proposed technique measure size and location and morphology of porosity. The reviewer also asked can the measured fields be input to finite element programs (i.e., is there a connection with weld modeling in component simulations. The reviewer stated nice graphical user interface. The reviewer then asked is it easy enough for a weld technician (who does not have a Ph.D.) to learn within 15-30 minutes or so. It is not clear as to the amount of effort required to train or calibrate the measurement system for different types of welds.

Reviewer 3:

This reviewer stated that the project addresses the major technical barriers of non-destructive weld evaluations. The approach is well founded and the project team is well constructed with OEMs, weld experts and suppliers. The reviewer added that future efforts on the weld tip degradation and part fit up are key efforts for the next fiscal year. Additionally, the reviewer said that the next barriers that must be addressed are system reliability for hundreds of welds per shift, maybe thousands of welds per day and cost of the systems.

Reviewer 4:

Although a mature inspection technique, this is still a big want for high volume NDE of spot welds in automotive

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 commented that the efforts on stick welds and undersized welds are encouraging. The reviewer added that the overall agreement between predicted and measured weld diameter is great, congratulations. This project is well along the path to achieving an

important goal for improved weld quality and nondestructive testing. An OEM testing site in Fiscal Year (FY) 2014 is the next critical step. The reviewer wanted to see more details on the training of the system.

Reviewer 2:

The reviewer stated that under controlled situations the new technique has shown to be very reliable and accurate. The reviewer added that the industrial trials are underway, which can prove whether the variations in the shop floor can be accommodated by the new software.

Reviewer 3:

The reviewer said that the project team developed an on line weld inspection system. The reviewer remarked that it would help to know the limit of resolution for the thermal imaging system. The reviewer asked what the smallest pore diameter that can be detected is (assuming a weld has porosity - this would be particularly important for laser welds in Al). The reviewer also asked if the authors have thought about combining their method with x-ray tomography. The reviewer inquired about limiting the thermal imaging. Additionally, the reviewer asked how fast the spot welds can be moving beneath the measurement system and still have the system give meaningful results. The reviewer asked is this process one where the weld movement stops, then the weld is measured, then the part is moved so that the next weld appears beneath the camera. The reviewer also asked how fast the part can be moving beneath the camera. The reviewer asked what the limit of weld thickness is. For example, it seems that the infrared technique will work for 1 millimeter (mm) x 1mm stack-ups. The reviewer also asked what that is increased to 2mm x 2mm stack-up.

Reviewer 4:

The reviewer stated that the system robustness still remains an issue but progress is being made with each review and development at ORNL. The reviewer added the project team should consider developing a supply base for the infrared (IR) system to build production systems and robust software

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer pointed out that this project is well connected via excellent collaboration

Reviewer 2:

The reviewer commented that there was good collaboration and coordination with the team members. The reviewer added that it is not clear what progress has been made on commercialization of this technology through licensing or other commercial arrangement.

Reviewer 3:

The reviewer commented that the infrared cameras are export controlled. The reviewer warned that industry cannot simply stick one of these on a production line without export clearance and strict control over who is using the camera, where the camera is stored when not in use, etc. The reviewer added that it appears that this will add some cost to any future implementation in a weld line. The reviewer asked if the PIs have discussed this with any of the U.S. automotive OEMs. The reviewer added that the project team is working with industry stakeholders.

Reviewer 4:

The reviewer remarked that the project has many industrial participants as advisors; no work was carried out by the industrial team but now one OEM is testing the product.

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 future efforts are clearly identified in the field trial and then commercialization. The reviewer added that the areas for future research, perhaps future projects, are less obvious from the presentation. The reviewer commented that the areas within the project are all surrounding the field test in a plant location, this will be critical to the project.

Reviewer 2:
The reviewer asked if there has been any thought as to how this infrared measurement system could be integrated in robotic welding where robots are moving at high speeds to make welds, or has the infrared measurement system limited to joining processes, which do not involve robots.

Reviewer 3:
The reviewer pointed out that this is the last year of the project; the plan for the technology transfer is good but has only one facility is testing it now. The reviewer remarked that the project team needs to increase the number of facilities involved. The reviewer added that it is understandable as the new patented technology the dissemination will be slow in the beginning.

Reviewer 4:
The reviewer requested that the project team develop a system for inspecting un-coated, highly reflective, Al spot welds, noting this is not easy but a big want in the automotive industry.

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

Reviewer 1:
The reviewer commented that it is all about lightweighting and the quality tools to deliver lightweighting; this IR inspection is perfectly aligned as an enabler.

Reviewer 2:
The reviewer said yes, real-time and/or post weld quality and evaluation schemes are critical for increasing the use of advanced high strength steels. These AHSS materials reduce vehicle weight and therefore displace petroleum.

Reviewer 3:
The reviewer stated that the online testing tool will improve the efficiency of the process. Spot welding is one of the most widely used joining techniques and improving the speed of this process will improve the implementation of multi materials in the vehicle structures.

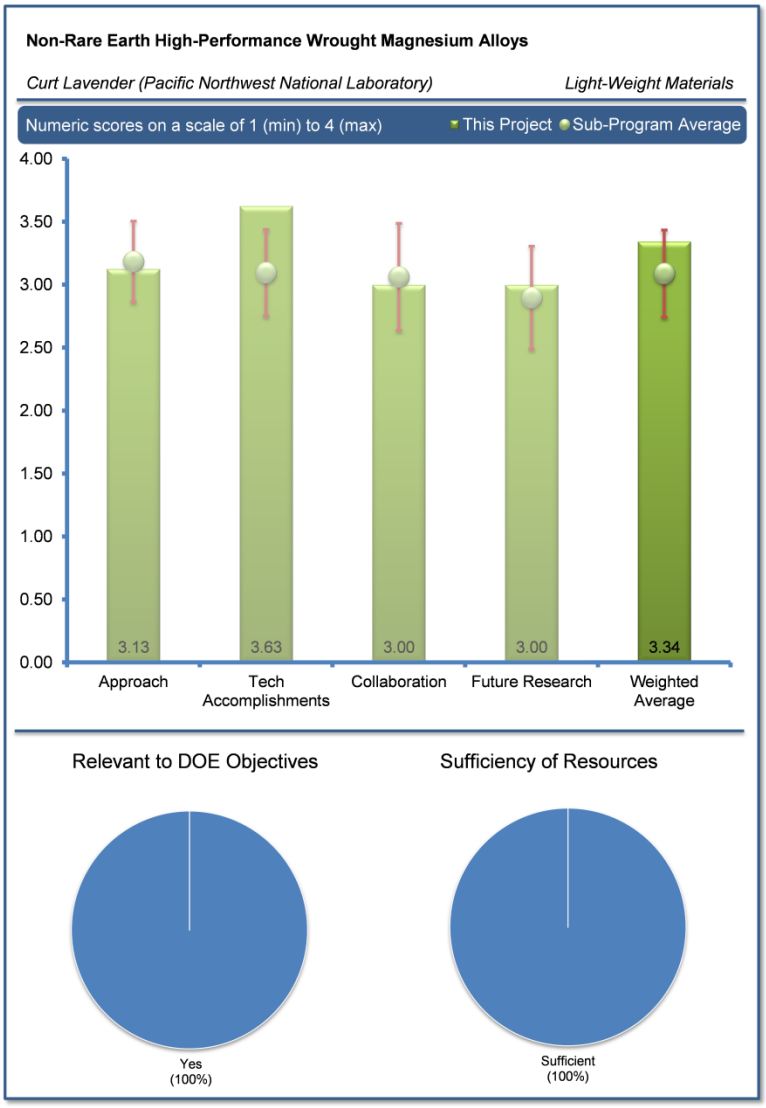
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
The reviewer said that resources are adequate.

Reviewer 2:
The reviewer said no changes, appropriately resourced.

Reviewer 3:
This reviewer stated that resources appear sufficient. The reviewer had a question about how to engage a supplier to bring this system to commercialization.

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



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 development of non-rare earth Mg alloys continues to be of great interest to the automotive industry and the reviewer encourages this work. The reviewer added that this is a well thought out approach and the jump to larger extrusions would be a great next step. The reviewer recommended that this work continue.

Reviewer 2:

The reviewer stated that this appears to be a well thought out project with a sensible focus on the challenging balance among properties, ease of manufacture and cost. The reviewer added that the description of the extrusion process was very good and helpful in understanding the approach but the presentation would have been strengthened a bit by having data on the conventional approach available as a comparator (for example, extrusion speed). Having such data in the presentation would have made the work easier to evaluate in terms of performance and manufacturability improvements. The reviewer also commented that the comparator with data for energy absorption of 6061 aluminum in the slide deck was very useful, given that (as the reviewer understands it) a key goal of the project was to develop an Mg alloy with properties that are comparable to widely used alloys of aluminum.

Reviewer 3:

The reviewer asked if the modeling work was multi-scale. In other words, the reviewer asked are the magnesium-silicone (Mg-Si) particle properties being predicted with discrete Fourier transform or some other computational technique. The reviewer then asked how much the modeling work relied upon existing experimental data. The reviewer asked what checks have there been on the quality of the existing experimental data upon which the modeling effort in this project draws (it seems that modeling relies upon crystal plasticity which has many unknown parameters). The reviewer stated that it seems that the modeling relies upon many unverified assumptions/inputs; however, the PIs can check to see what the origin of all parameters in the modeling is (e.g., good guess, literature data, and data produced in the project). The reviewer then asked why the load versus displacement curve for the AA6061 alloy is so smooth, but undulatory for the Mg/Mg-Si materials. The reviewer also asked if the oscillations are truly due to fracture nucleation, or are they some type of ringing artifact in the measurement system. The reviewer asked is the fracture modeling in this work based upon microstructure and microstructural defects (inclusions, etc.). The reviewer also asked if not, why not.

Reviewer 4:
The reviewer remarked that the justification to the selection of the alloy systems needed to be explained more. The reviewer asked what other alloy systems were considered and what the rationale for selection of ZK60 alloy was. The reviewer added that the reason to conduct experiments using Mg-Si systems was explained but similar reasoning for ZK60 would be helpful.

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 said that the process could be developed and scaled to larger extrusion; this is truly an advancement for Mg alloys. The reviewer particularly liked the linkage between the ICME studies and the process conditions that allow you to micro-tailor the properties. The reviewer said well done.

Reviewer 2:
The reviewer remarked that the development of the new extrusion process can produce fine micro structures in Mg alloys is good. Also, the reviewer said that the modeling efforts to explain the strengthening in the alloys during extrusion are good development; however, it is necessary to compare the process for the existing alloys.

Reviewer 3:
The reviewer stated that the extrusion patent application has been filed; good to see that emphasis is not solely on writing publications and reports. The reviewer added that intellectual property is critically important.

Reviewer 4:
The reviewer commented that it appears that many or most of the goals as stated in the project have been achieved and this is great, but again, a more direct comparison of project data with that for conventional alloys (of either aluminum or other Mg materials) would have been helpful. The reviewer is always interested in cost data and estimates (which the reviewer recognizes are very challenging to develop in a research project), but little was said about cost and this is something that will eventually determine the applicability of this technology to commercial production. The reviewer stated that it is just a stylistic point, but charts or tables of data are more informative than wordy slides when trying to compare data from different materials.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that collaboration appears to be very strong and efficiently organized.

Reviewer 2:
The reviewer remarked that there was good collaboration with Georgia Technology. The reviewer was still looking for the part that Magna might make and the reviewer will follow up with them with a few automotive ideas. The reviewer thought extruded valves for use in a transmission valve body; the project team has the right size die to make us parts.

Reviewer 3:
The reviewer commented that the only technical partner is Georgia Technology and others are not contributing technically to the project. The reviewer added that the project is developing new processes it will be beneficial to Pacific Northwest National Laboratory (PNNL) which is carrying out the bulk of the work; however, it is necessary to involve some commercial extruders to scale up the process.

Reviewer 4:
The reviewer asked who the end users are to be of the Mg extrusions being developed in this project. The reviewer also asked have the PIs communicated with any companies in the mobility industry. The reviewer asked can enough material be made from the process being developed in this project for suitable scale up for mass production. The reviewer then asked if the project team had put any thought to costs of Mg extrusion versus 6XXX alloy of interest in this project. The reviewer asked how often the PIs from Pacific Northwest

National Laboratory (PNNL) meet/speak with Georgia Technology group. The reviewer said good leveraging of DOE/Basic Energy Sciences in this 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:
The reviewer stated that PNNL is encouraged to continue this work as the reviewer has not seen this level of depth in academia and coming from a national laboratory it puts it closer to industrial application. The reviewer said the project team should consider a linkage with Ames in the future regarding critical materials and replacing rare earth's, which would be a potential collaboration with another DOE funded program.

Reviewer 2:
The reviewer stated that the scaling up process is the next step proposed; this is important as the new technology needs to be proven in large volume production. The reviewer also noted the scaling up of the sizes from the current 5mm wall thicknesses.

Reviewer 3:
The reviewer asked if a technical cost model for the proposed extrusion process planned for the future. It is not quite clear what the future work will be other than scale up; however, for scale up to work there needs to be a customer base and this has not been defined. The reviewer then asked how one knows that the extrusion process and material produced per pound (with the improved properties) do not outweigh cost-advantages for the Al alloy.

Reviewer 4:
The reviewer may have missed it, but this portion of the presentation appeared to not be as well developed as other components and the reviewer would have appreciated a list of upcoming tasks.

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

Reviewer 1:
The reviewer commented that Mg along with CFC is identified as the best potential for lightweighting; however, the reduced ductility and increased cost of rare earths make the Mg not suitable for crash sensitive applications. The reviewer added that improving the dynamic fracture behavior without increasing the cost is important for the Mg to be used effectively in vehicles. This project is developing a new manufacturing process to overcome these two shortcomings.

Reviewer 2:
The reviewer noted that reducing weight is foundational to DOE goals and this will require new materials and new manufacturing processes and thus, enhancing the properties and manufacturability of Mg is essential in the reviewer's view.

Reviewer 3:
The reviewer stated that although this was not discussed, reduction in mass of ground transportation vehicles seems to be an overriding goal of this project.

Reviewer 4:
The reviewer stated that Mg and CF are both of great interest and on our roadmap for vehicle lightweighting.

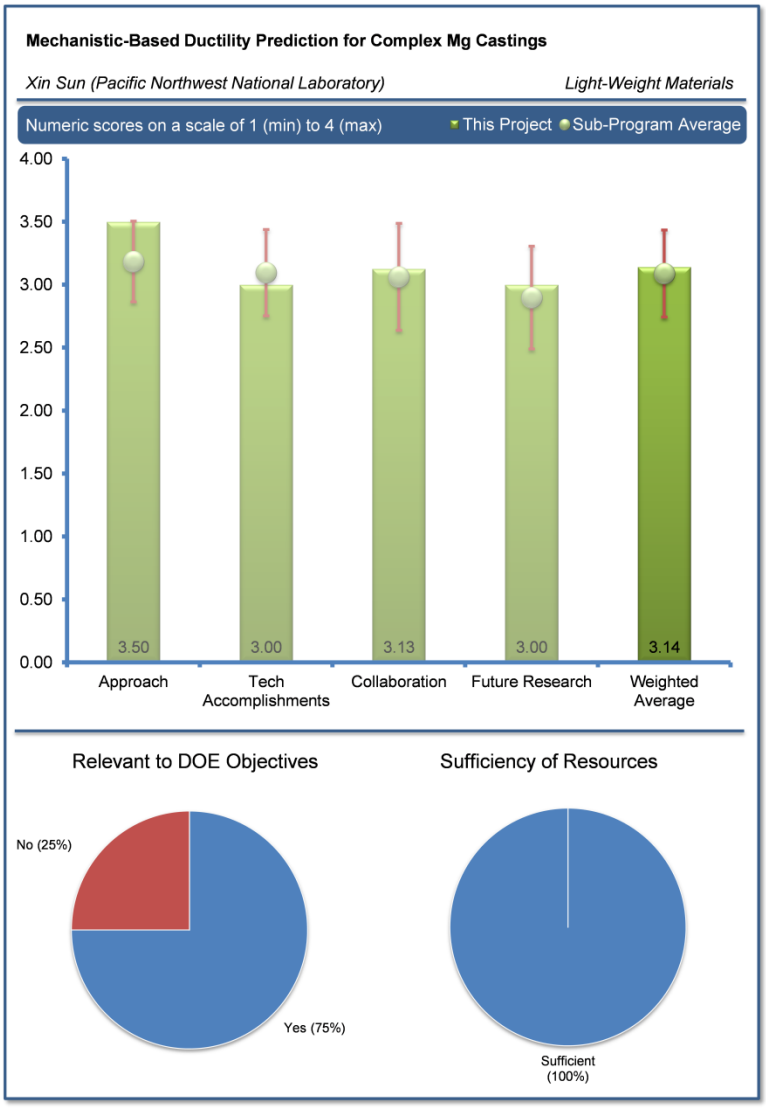
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
The reviewer described resources as okay.

Reviewer 2:
The reviewer said just right, no changes.

Reviewer 3:
The reviewer asked where all of the data being generated in this project is being saved/archived/curated. The reviewer also asked if there was a SharePoint site at PNNL that has been developed for this purpose.

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



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 said that the project team had an interesting scientific approach. The reviewer added that the project was strongly dependent on ensuring that the casts created under controlled conditions vary according to the major variables that affect the cast quality. The reviewer stated that the project team had a very interesting approach to address a very complex problem. Essentially the team is investigating the main effects of a variety of variables across the thickness of the casting. Some of these main effects are difficult to extract and the team has developed some interesting ways of getting at these effects. The reviewer suggested that future work (beyond the scope of the current project) depending on the degree of correlation from the main effects, investigate interaction effects.

Reviewer 2:

The reviewer remarked that the team seems to have a good understanding of what is needed and clear direction to get the needed information.

Reviewer 3:

The reviewer said excellent approach, one likely to be used by the industry. The reviewer noted the importance of Mg alloys in lightweighting applications. The reviewer noted the variation in casting (e.g., defects, surface quality, etc.). The reviewer also noted the predictions based on empirical methodology and mechanistic approach.

Reviewer 4:

The reviewer commented that the measured ductility appears to be dominated by extrinsic factors (porosity) which provide considerable scatter in the data, limiting its commercial use. In the reviewer's opinion, the work plan was flawed.

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 commented that very good progress has been made from the 2013 review, better focused and more thorough.

Reviewer 2:
The reviewer remarked that there was good progress in modelling and in correlating with test results.

Reviewer 3:
This reviewer commented that the team has made good progress on the variety of investigations as presented. It would be good to get an overview slide that shows the relationships between the various tasks (perhaps a fishbone diagram or other conceptual based diagram that relates the variables and their investigation to the goal of ductility prediction). The reviewer added that the project is still very difficult to understand.

Reviewer 4:
The reviewer indicated that predictive results and measurement do not correlate, thus they are not applicable to commercial use. Local material property prediction and correlation with actual test samples is an objective of ICME and in fairness to the researchers will require significant research effort over the next 10 years to achieve.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer thought that the degree of collaboration was evident from the number of different participants in the room from the project answering questions, as well as their respective roles in investigating specific variables to feed into the various prediction soft wares. The demonstrated collaboration is among the best of the 10 projects the reviewer reviewed.

Reviewer 2:
The reviewer stated that there appears to be good cooperation and coordination between PNNL, Ford, University of Michigan (UM), Mag-Tec and Canmet.

Reviewer 3:
The reviewer commented that the collaboration is good. The reviewer expressed interest in seeing the partners be more involved than presented.

Reviewer 4:
The reviewer stated that the role of Canmet and UM appear to be window dressing for the application. The reviewer recommended that future projects include magnitude of inking from each collaborator.

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 noted that the future research is straightforward following the plan and pursuing the goal. The reviewer added that there are some details that are fuzzy, such as the leap from the detailed models to the software and the correlation with the quality map, if that is planned. This begs the question what the risks are and the risk abatement plan, assuming there is still time to even do anything about them.

Reviewer 2:
The reviewer said that the proposed work looks good. The speaker indicated that the results of this work should be applicable to an array of Mg alloys and to Al alloys. It would be good to verify that.

Reviewer 3:
The reviewer remarked that the project team did excellent work but the project is on its last trimester and it is more a question of finishing what has been commenced than starting new ideas. The reviewer added that even though the dimensions of cast samples match

thicknesses of larger cast parts, the thermodynamic effect on large casting can have drastic effects on the microstructure and yield different results than from small samples.

Reviewer 4:
The reviewer recommended to "put a bow on it."

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

Reviewer 1:
The reviewer stated that casting is a major process by which Mg will be added to automotive body structures. Adding Mg to body structures is a key factor for light weighting. Understanding Mg casting to the point where the process and product can be simulated for both manufacturing quality and product performance is essential. The reviewer added that this is one project of several that will help accelerate the adoption of Mg castings. Additional projects are necessary in this area (measuring porosity formation, developing porosity models, etc.)

Reviewer 2:
The reviewer noted that if successful, this project can enable more extensive use of cast Mg (and possibly Al), which in turn will enable reducing the mass of vehicles, and increasing their efficiency.

Reviewer 3:
The reviewer mentioned that any additional material knowledge can lead to weight reduction and, therefore, saving fuel.

Reviewer 4:
The reviewer pointed out that ICME and automotive fuel savings are not rated. ICME efforts related to local material property prediction does not provide tangible mass reduction, but rather an improved understanding of the problem.

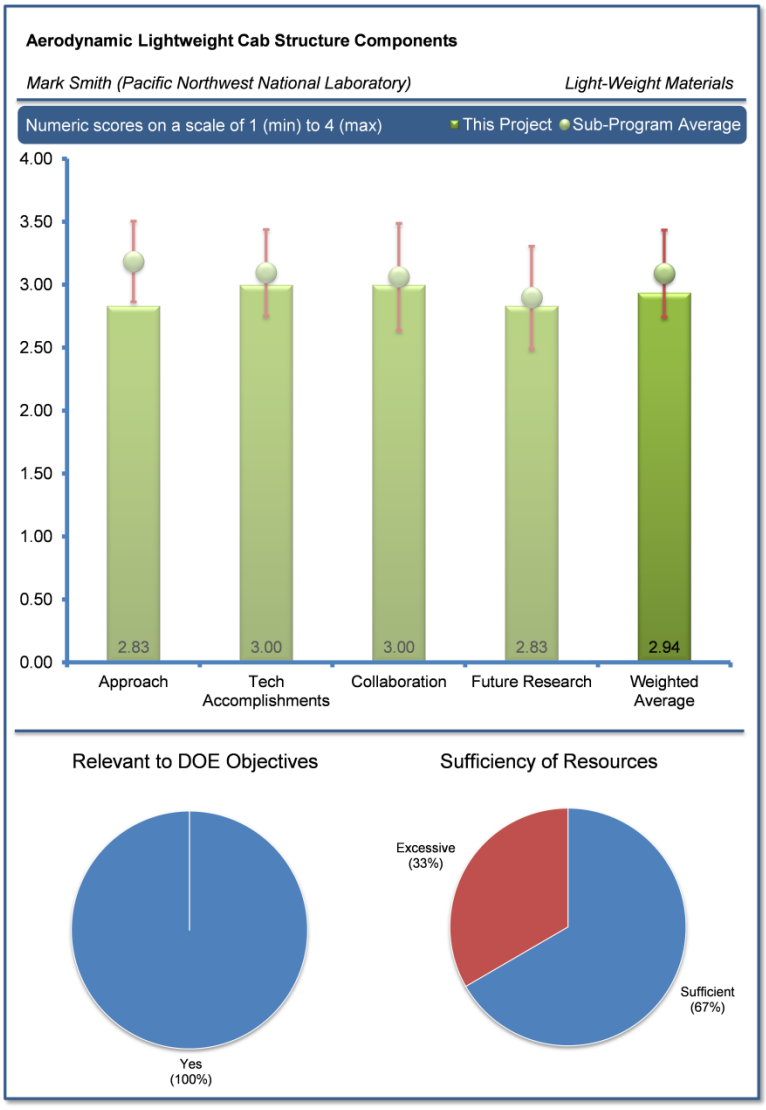
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
The reviewer stated that for this project the funding appears sufficient; however, without understanding the gaps and risks of the remaining work, it is a bit difficult to assess.

Reviewer 2:
The reviewer remarked that it is sufficient because the PI is working more than reasonable.

Reviewer 3:
The reviewer commented that the findings or lack thereof indicate that the problem is much larger than assumed.

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



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 did not see quantitative goals and success to goals. The reviewer added that the approach is very straightforward. The reviewer said that the degree of ICE or other simulation tool integration was unclear. The approach appears to target a specific component and is based on trial and error. The degree of generalize of the knowledge gained from the project to other components with different geometry is unclear.

Reviewer 2:

The reviewer said that the approach appears to deviate from direction of earlier phases. Last year's work had significant emphasis on simulation of the heating steps, and results. The reviewer added that this year the emphasis appears to have been on using empirical techniques to determine a production process for producing a specific family of parts for test rather than on more generally applicable techniques.

Reviewer 3:

The reviewer noted that this was a cooperative project with PACCAR. The reviewer said that the project team had a straightforward approach and that the project can represent a substantial benefit for the trucking industry. The reviewer added that the project was necessary work but, as presented, appears boring.

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 remarked that if one interprets the stated project goals to apply only to the selected part, then progress appears excellent. The team has determined the process parameters needed to form the A-pillar. If one however, interprets the project's goals to develop a warm forming process that is applicable to a broader set of geometries, the project still appears to have some major barriers, specifically with regards to process parameter determination. The reviewer questioned whether the same process parameters would work on a larger, deeper draw panel or a more complex shape part. Further, if the process parameters did need to be altered for a different part, could they be determined from simulation, analysis, or other non-empirical method. This reviewer is under the impression that a significant part geometry deviation would require an empirical determination of new process parameters (such as temperature profiles). The reviewer

considers this a barrier, and the project's progress does not appear to address this barrier. At a minimum the performers have to state the limits of the process with regards to material and forming geometry as it is understood whit the current process parameters.

Reviewer 2:
The reviewer stated that the project addresses hurdles for this particular product in this particular alloy. It is difficult to determine how to apply those findings to other alloys or product forms.

Reviewer 3:
This reviewer commented that the project was well conceived but limited and will lead to meaningful results. The reviewer added that it probably reflects the culture of the industry.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that there were strong linkages between PNNL, PACCAR and Magna SCFI is evident.

Reviewer 2:
The reviewer commented that the collaboration between PACCAR and Magna appears excellent. They work together appropriately on their respective work tasks. Novelis's involvement beyond simply supplying the material is a bit less clear for FY 2013.

Reviewer 3:
The reviewer commented that even though PACCAR is important for the trucking industry, the project should significantly increase its membership.

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 is not going to keep commenting on the generalizability of the results. The project is in its last year. The future work is very straight forward (i.e., make parts and test for paint, bake, and performance on vehicle). This is a validation task that is important, but not particularly risky.

Reviewer 2:
This reviewer remarked that no future plans were explicitly stated. It appears that all that remains is for PACCAR to paint mount and test the 25 pairs of parts. Since this is not a very demanding application, the reviewer is not confident that much of value to anyone but PACCAR will be obtained.

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

Reviewer 1:
The reviewer commented that weight reduction in the cabin will translate into a larger cargo, therefore the price per unit freight will diminish. The reviewer further noted that this is also petroleum displacement.

Reviewer 2:
The reviewer stated that developing advanced forming processes that are demonstrated to work on lower density alloys, such as Al, will help industry adoption of these alloys to lighten vehicles, improve fuel economy, and reduce petroleum use.

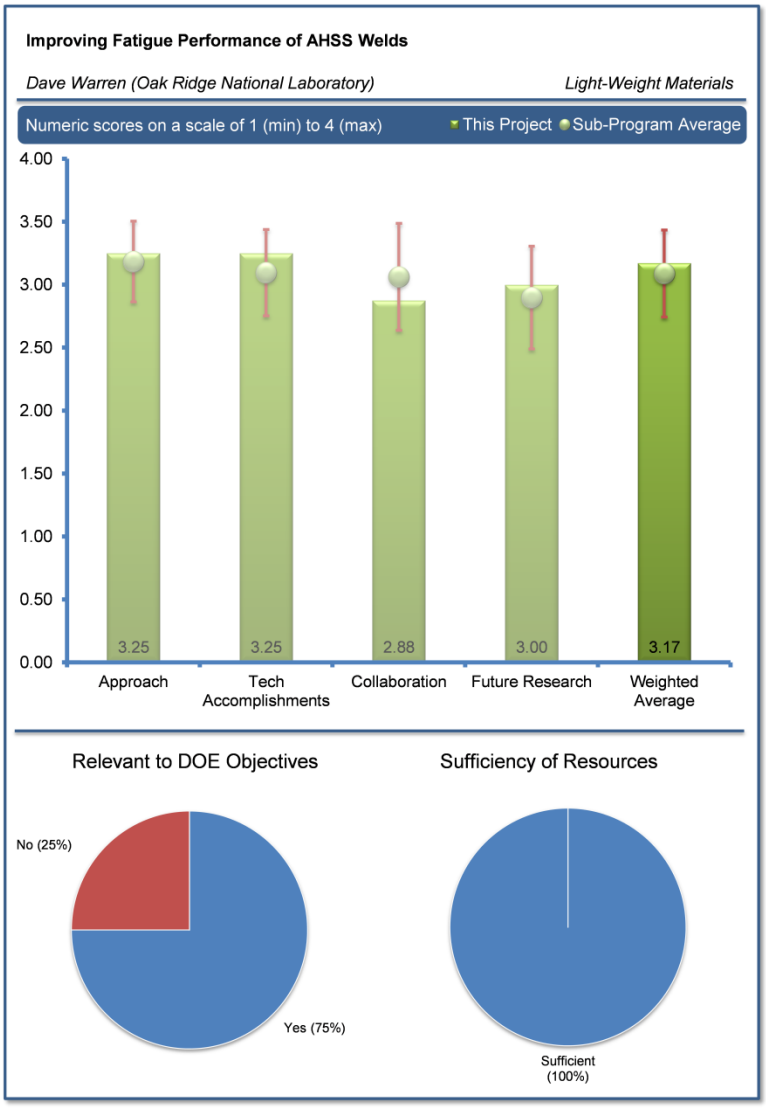
Reviewer 3:
The reviewer stated that in principle, the goals of this project are relevant to DOE's objectives. The reviewer added that it would enable improved aerodynamics (thereby reducing drag and improving efficiency) while also reducing vehicle weight. In actuality, however, it is not clear that the results of the work will be generally applicable, and thus may not actually be highly relevant.

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

Reviewer 1:
The reviewer said that the team should be able to complete the project within the project's budget.

Reviewer 2:
This reviewer concluded that $1.2 million of DOE funding to develop a manufacturing process of limited applicability seems excessive.

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:

The reviewer commented that this still remains to be a significant development as a look up table for the fatigue performance of AHSS weldments. Having a design guideline will further present options to the design and release engineer to develop a robust joint design.

Reviewer 2:

This reviewer said good effort; a significant improvement in the area of understanding weld quality and IR imaging has been realized. The reviewer added that the research effort extended to pre-commercialization state for application real time and post weld validation.

Reviewer 3:

This reviewer stated that the project is focused on developing a solution for the problem of low fatigue strength of welds in AHSS. The proposed plan was good which had been successfully executed. The reviewer added that the work can be termed success as a good solution was found along with capability to simulate the welds.

Reviewer 4:

The reviewer asked how the weld fracture (e.g., in transformation induced plasticity steel spot welds) is incorporated into this project, or is it. The reviewer also asked what the interplay is between fatigue and fracture in the welds of interest in this project. For the digital image correlation (DIC) measurements under high temperatures, are the PIs correcting for heating of the surrounding air, this can greatly skew the DIC results (if not appropriately corrected for).

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 this project had an excellent overall deliverable, very focused on AHSS with plenty of opportunity to expand to other lightweight systems like Al weldments.

Reviewer 2:

This reviewer indicated a very good result, illustrating practical application of IR imaging and real time processing. The benefit of providing real-time inspection is associated with reducing the number of welds (increased weld spacing) and lower manufacturing cost.

Reviewer 3:
The reviewer stated that the project team developed new material as well simulation capability to predict the weld performance; the weld performance was significantly enhanced by the new material. The reviewer added that this will help auto makers to confidently use the new grade AHSS for the structures.

Reviewer 4:
The reviewer asked if the finite element model (e.g., the as-meshed model) has been compared with a real weld joint. The reviewer also asked what constitutive models were being used for the weld materials in the finite element (FE) models and how have these been validated. The reviewer also asked if the new special filler wire will add more cost to existing welding processes. The reviewer added that it would be helpful to show more of the modeling results and then validation of modeling results against experiments. The reviewer then asked if this will be possible for next year.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
This reviewer stated that there was good collaboration with Arcelor Mittal, modeling software suppliers and industry partners.

Reviewer 2:
This reviewer said that there was good collaboration; the project needs to be applied to production environment and then a non-destructive testing (NDT) firm needs to commercialize the technology. Commercialization need not take place at the lab. The model should demonstrate and validate for commercial use and move on. The reviewer added that the next step of collaboration is to disseminate the methodology to the public domain.

Reviewer 3:
This reviewer indicated that the PIs have sampled OEMs on weld patterns. The reviewer asked how the PIs are coordinating the sharing and transfer of data between the different institutions involved in this project (e.g., ArcelorMittal, Colorado School of Mines). The reviewer also asked who is integrating the results from these different groups to address the fatigue issue in the welds.

Reviewer 4:
The reviewer stated that the project has one stakeholder (ArcelorMittal) who is providing material support; the work is carried out the research and development (R&D) organizations. As this is a cooperative research and development agreement (CRADA) the total contribution from the industrial partner need to be quantified.

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 indicated that this work will be excellent if continued expansion into press-hardened steel (PHS), hot stamped steels and high strength (HS) Al alloys like 7075.

Reviewer 2:
The reviewer said that this is the last year of the project; from the presentation it is obvious that the objectives of the proposal were met; unique solutions were provided to the problem of low fatigue strength of welds.

Reviewer 3:
This reviewer indicated that commercial trials are the next step.

Reviewer 4:
The reviewer was not quite sure how the planned future work will be integrated to address the fatigue issues in this project. The PIs need to think about other AHSS, such as fully martensitic and press hardened steel with ultimate tensile strength (UTS) values in excess

of those currently being investigated. The reviewer then asked if the results from this study will be such that computer-aided engineering (CAE) engineers might be able to use it in simulations of welded AHSS components. The reviewer also asked if this work will result in weld constitutive models that are materials based rather than component based for the weld zones.

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

Reviewer 1:
The reviewer stated that welding is one of the major joining processes used for the vehicle assembly; improving the fatigue performance of these joints is useful in enhancing the durability of the structure. The good understanding of the problem and novel solution for that will pave the way for increased use and reliability.

Reviewer 2:
This reviewer said that the project was especially relevant for B pillars, lower A pillar and truck frames, all of which are going toward more dual-phase steel (DP), PHS and hot stamped steels.

Reviewer 3:
The reviewer asked if the proposed concept, in-process residual stress modification during welding, is viable from a cost and process intensity standpoint for use in the auto industry. The reviewer stated that any modifications or enhancements to existing weld schedules for vehicle components are likely to add costs. The reviewer asked if some thought been given to weld modifications or enhancements.

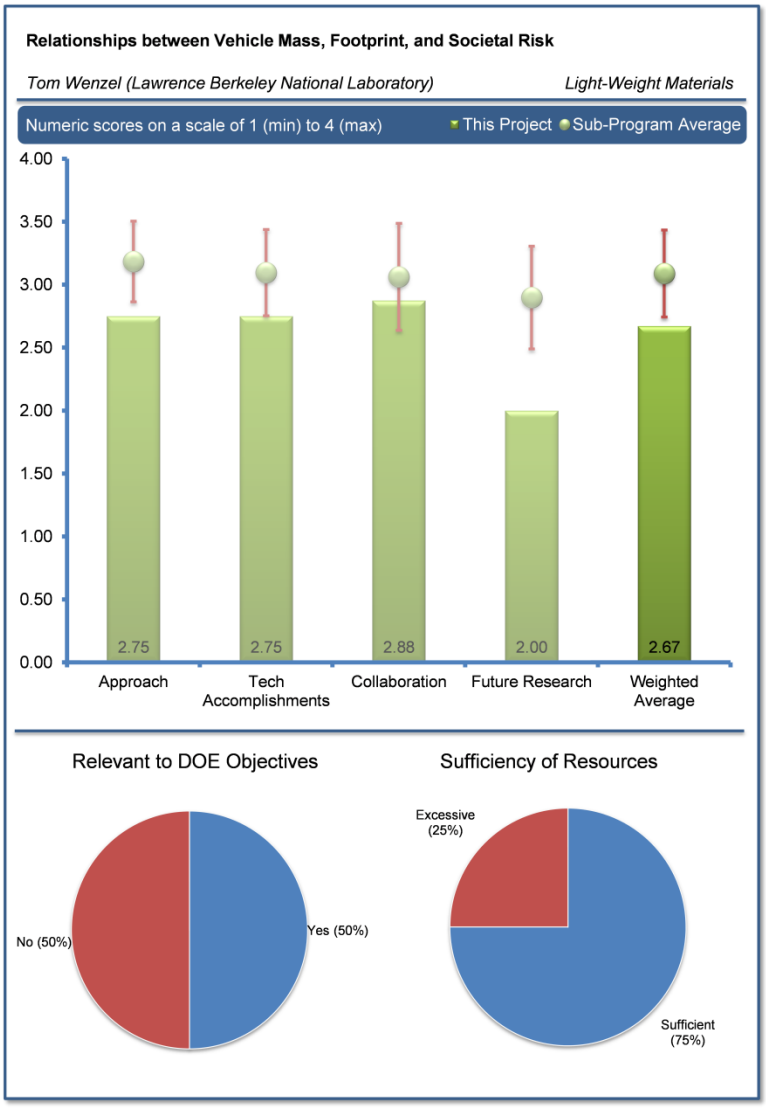
Reviewer 4:
The reviewer pointed out that weld quality of steel does not correlate with fuel reduction. The reviewer added that the project team needed to point out cycle time and the cost reduction benefits of reducing the number of welds.

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

Reviewer 1:
The reviewer indicated that the project was very well staffed and managed. The reviewer also said good job.

Reviewer 2:
This reviewer pointed out that no additional funding is required but current levels should be kept.

Relationships between Vehicle Mass, Footprint, and Societal Risk: 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 indicated that this project is doing a good job at the approach to overcoming the concern that mass reduction may reduce societal safety. The two analytic approaches are good choices for the study. The reviewer pointed out that the similarities, differences and shortcomings in each approach and the data sets employed give the level of transparency and honesty that this study requires.

Reviewer 2:

The reviewer said that it appears that the project leaders are going to great lengths to be objective in their analysis; however, adding driver demographic variables did not seem to help in identifying strong trends. While the reviewer is not generally in favor of adding more variables (as they may tend to cloud the results), the reviewer thinks including things such as vehicle age would be worthwhile, since safety standards (such as roof crush, side airbags, etc.) have changed markedly over the years.

Reviewer 3:

This reviewer stated that the regression analysis is time consuming and an "art." Without more details it is impossible to evaluate the approach. For example, in one of the presentations the team mentions they use a sequential regression analysis to add and remove variables. The reviewer then asked what validation methods were used. The reviewer also asked what alpha values were used and how were they justified. The reviewer then asked how the hypotheses were generated. These details are lacking, but very much go to the core of the “approach.” Further, the reviewer questioned whether following the National Highway Traffic Safety Administration (NHTSA) approach is of sufficient value. Simply duplicating or following similar lines of reasoning may not yield benefits for the DOE. The reviewer stated that if the purpose is to address the public's concern that lighter smaller vehicles are not safe relative to larger, heavier vehicles, then the study should focus on that particular aspect. The reviewer then asked how a lighter vehicle (controlled for the usual factors) will perform relative to a heavier vehicle.

Reviewer 4:

The reviewer stated that even though the reviewer appreciates the effort being made to establish the effect of vehicle weight in relation to societal risks, the reviewer is still not convinced that the presented correlations give a meaningful relationship between weight and accidents. The reviewer then asked if there is any other analysis technique that would validate the present results. It would be desirable to have car makers participating in such a study. The reviewer then commented that small cars is a relatively new phenomenon in the

United States, would it be more meaningful to look at data from some European countries where the small car population is much more significant and for a much longer time frame.

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 progress on the technical accomplishments is satisfactory. There has not been much substantial progress from the 2013 Annual Merit Review (AMR) report. The efforts on risk by model are illustrative but few strong conclusions can be drawn. The reviewer indicated that the work on the breakpoint in weight where mass reduction changes from a detriment to a benefit is intriguing. This area warrants further investigation. Also, the reviewer indicated interest in the differences between self-safety which is prime in single vehicle crashes for fatalities and serious injuries, and the effects of mass plus size on multiple vehicle incidents. Perhaps the societal risk is reduced because self-safety will remain unchanged but reducing mass in heavier vehicles is good in reducing societal risk.

Reviewer 2:
The reviewer stated that there was good progress in analysis, but unfortunately not in establishing a conclusive link between size, weight, and safety.

Reviewer 3:
The reviewer said the progress appears to be satisfactory, but asked if the project should be continued.

Reviewer 4:
The reviewer said that the technical accomplishments were to continue to add additional variables (not related to weight) to the overall model to determine whether the error in the model was sufficiently reduced to determine the effect of curb weight on crash frequency and crash worthiness. The reviewer added that the models could not be improved to such a degree to determine that cause and effect; however, the performers did not present any statistics, (power or beta error) that would indicate whether they even need to reduce the noise further (given the relative low R2 of the models the reviewer is guessing that the power is low). Further, there is no statement as to the magnitude of effect the project team is trying to detect with regards to curb weight. The reviewer then asked if the project team is trying to detect a 1% increase in frequency due to 50 lbs. in curb weight increase at a 95% confidence. Without such a statement, this project could go on ad infinitum. The reviewer then stated that the project team must also check the variance inflation factor of the entire X-matrix before model building every time the project team introduces a new variable. Lastly, the project should investigate possible model validation methods or statistics, such as the PRESS statistic (popular in the late 80s, early 90s - may be better ones by now). The reviewer would also like to know how the architecture of the model is determined with so many variables (non-linear and interaction effects).

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer indicated that the speaker indicated closely working with NHTSA, Volpe and the U.S. Environmental Protection Agency (EPA) on data, variables and methodology. It appears that the information gained in this project will be used by the U.S. Department of Transportation and the EPA.

Reviewer 2:
The reviewer commented that the slides relating to collaboration appear to have a satisfactory listing of collaborators. The reviewer added that there was little evidence of collaboration in the presentation. Though perhaps, regression analysis is not a great example of a team sport.

Reviewer 3:
The reviewer stated that in order to get access to the data as well as gain acceptance of their results, the collaboration with the other federal and state agencies must be excellent. That said, the reviewer wondered whether their closeness biases the performers view to follow similar approaches taken by those agencies.

Reviewer 4:
The reviewer pointed out that carmakers are absent from the study, while they should be represented.

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 analysis apparently is required for midterm review of federal standards, so some additional work will be required. The reviewer would like to see analysis aimed more at why differences occur rather than if differences occur. Thus far the most significant finding is that (unexpectedly) there is a higher crash frequency in lighter vehicles, it would be beneficial to understand why that is. Also, the reviewer pointed out it would be beneficial to understand why a poor driving record reduces crash frequency in light trucks and crossover utility vehicles/minivans.

Reviewer 2:
This reviewer does not believe adding more variables to the current modeling method will yield any significant results. These performers must change their approach. The reviewer would suggest that alternative model formulations, such as taking an engineering approach to model formulation and using regression modeling to validate the hypotheses, should be investigated. For example, if the public is concerned about heavy on light vehicle crashes, particularly that lighter vehicles are less likely to survive in such crashes, then test that hypothesis (controlling for driver age, vehicle safety devices, etc.). The reviewer added that if a vehicle is involved in a stationary accident, such as a tree, and then gives the tree a very large weight (infinite). If it is involved in stationary with a parked vehicle, then it is the same as a two vehicle accident. If this reduces the data set for some reason, then so be it. The reviewer went on to say that the independent variable should not be curb weight of the vehicle, but rather difference in curb weight between the vehicles. This might also change the approach of creating separate models by vehicle type. The reviewer mentioned this as an example off the top of my head as a non-safety expert.

Reviewer 3:
The reviewer said fair because the reviewer did not know what to say.

Reviewer 4:
The reviewer stated that the proposed future research of, "... illuminate relationship between vehicle mass, size and safety" should be discussed with more details. The reviewer added that the two proposals sound okay, but the reviewer wanted more details on the next steps. The reviewer suggested that perhaps a hypothesis to test with the regression analysis would be helpful here, in particular, looking more closely at single versus multiple vehicle incidents.

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

Reviewer 1:
The reviewer stated that as a nation, we need facts and an enlightened discussion of petroleum demand, societal safety and societal benefits of mobility. The "third rail" issue of safety needs these sorts of facts and deep statistical studies.

Reviewer 2:
The reviewer pointed out that the present results seem to indicate that heavy vehicles are safer than lighter ones.

Reviewer 3:
The reviewer commented that the project team should demonstrate that "small" is not automatically worse than "large" in vehicle safety, so as not to dissuade consumers from buying smaller or lighter vehicles.

Reviewer 4:
The reviewer indicated that this team needs to change its approach and provide a greater value and that being a team the ostensibly duplicates or runs parallel to NHTSA modeling so that regulations are transparent. That type of work should be supported by public non-profit, not DOE's VTO. The reviewer added that DOE VTO should support projects that can statistically determine whether the public's concern regarding vehicle size and weight are valid, but the reviewer fears that the current approach taken will not get that answer and a more aggressive modeling approach that targets that question is required.

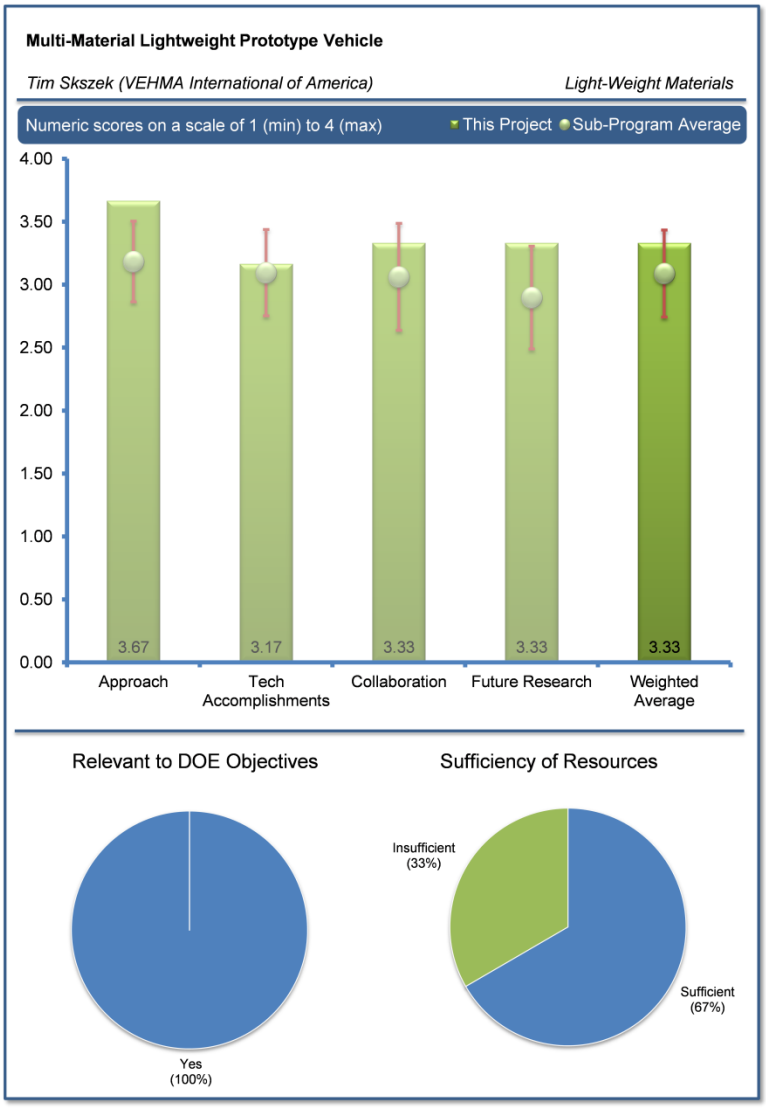
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
The reviewer stated that it is hard to judge the resources here. The reviewer had hoped for more progress so maybe there needs to be more resources applied to this project.

Reviewer 2:
The reviewer guessed that resources were sufficient.

Reviewer 3:
The reviewer said that the current approach is not likely to achieve the desired goals of the DOE and therefore, the project in its current form should be cancelled. The reviewer added that if the project is redefined and scoped, then additional funding may be required.

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



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 stated that the approach is very good given the complexity and comprehensiveness of the project. The reviewer stated that the reviewer's positive feedback on the other review areas would not be possible without the overall approach being able to accommodate both the project goals and the constraints placed on the project from cost, availability of technologies, and commercial interests. The reviewer did not see how the project could have taken a better approach.

Reviewer 2:

The reviewer indicated that the project team had a reasonable approach given the relatively short timeframe and limited resources; however, the analysis suffers from a number of compromises and estimates to guesstimate mass save, since they are building on a 2013 Fusion rather than the original 2002 Taurus baseline (referred to in last year's report).

Reviewer 3:

This reviewer asked how the project team knows that a critical component has not been overlooked in a project this complex. The reviewer reported coating and/or painting/corrosion testing, and structural testing.

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 said that the project team made very good progress. The reviewer added that it is hard to believe that there should so much difference between 2013 and 2014.

Reviewer 2:

The reviewer stated that the technologies developed and implemented are both effective as well as of commercial interest. While some of the deadlines are slipping, it is not a major concern as of yet; however, this should continue to be monitored. It is interesting to note the wide variety of areas that were included for lightweighting (powertrain, body, chassis, interior, etc.). The reviewer believed that as the project progresses, the major gaps to further advancements will become clear.

Reviewer 3:
The reviewer stated that the project team has made great progress in producing prototype parts and mule vehicles; however, most of those appear to have been made using technologies that are available and in use somewhere in the industry, rather than focusing on new technologies that would ultimately yield closer to the 50% mass save target.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer remarked that the roles and responsibilities are clearly defined. Despite the overall complexity and large number of partners, coordination and cooperation appears to be working well. The reviewer also expressed congratulations to NCMS.

Reviewer 2:
The reviewer pointed out outstanding collaboration between Vehma and Ford is evident; however, there is no indication of the amount of "collaboration" versus simply purchased parts from other suppliers listed in the reviewer slides (Sabic, Corning, Autoneum, Michelin, etc.)

Reviewer 3:
The reviewer stated that the project is geared towards one particular vehicle, but lightweighting is not Ford's privilege focus. The reviewer would have liked to see whether similar projects were contemplated for 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:
The reviewer indicated that future plans are in line with the overall program and straightforward. The reviewer believes there is a high probability of success. The reviewer also recommended the team should begin identifying major gaps that if addressed in the future would enable major weight reduction improvement. The reviewer stated that this project should be able to help identify VTO lightweighting goals for the next five years.

Reviewer 2:
The reviewer observed that the future plans appear focused on identifying additional barriers but not on finding a way to address them.

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

Reviewer 1:
The reviewer noted that this project is at the core of what VTO is doing. It is a culmination of a wide variety of technologies and demonstrates how much of the advanced technology has made it to the commercial level, the current state of the art with respect to light weighting, and gaps that still need to be addressed.

Reviewer 2:
The reviewer stated that the goal of achieving 50% mass save is absolutely relevant to DOE's goals.

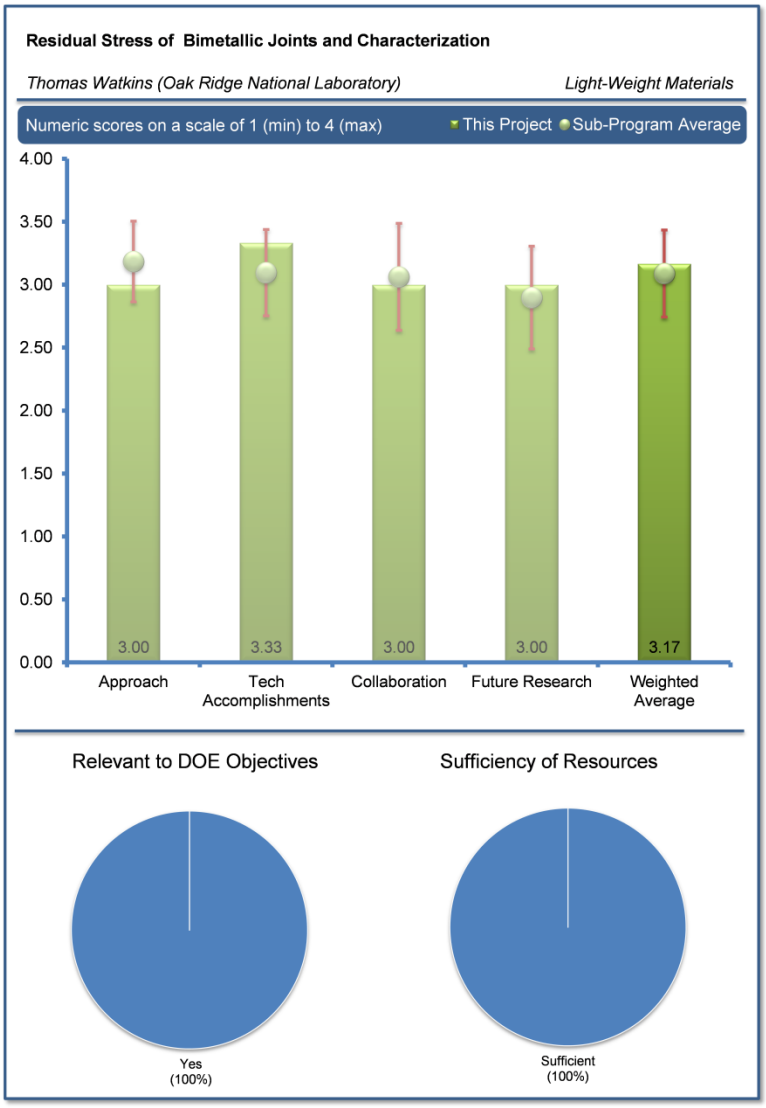
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
The reviewer said that the resources appear sufficient. The reviewer added that clearly resources limit the scope that can be addressed, but at the same time they are large enough to make significant advancements and achieve the VTO goals.

Reviewer 2:

The reviewer claimed that it is not feasible to develop all of the technologies required and to demonstrate them for the $10 million of DOE funding awarded.

Residual Stress of Bimetallic Joints and Characterization: Thomas Watkins (Oak Ridge National Laboratory) - lm073



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 stated that this project is very important work, appears to be very well organized and progressing well despite the complexity of the tasks being undertaken and the number of participants. The reviewer would suggest that a slide like Slide 10, which lays out the program, be converted to a graphical format rather than a list of words. This makes it easier to see how the various tasks and project components fit together.

Reviewer 2:

The reviewer commented that the work plan is sufficient to address the need; however, more work can be performed. For example, the reviewer said the nature of the interface needs to be explored further. Even though it has been told that the interface is a simple mechanical bonding this has to be confirmed.

Reviewer 3:

The reviewer asked if there is any experimental data with which to validate the phase property modeling. The reviewer also asked if there was a constitutive model used for the two-phase (mush region) to account for the fact that below the coherency temperature in the Al that the material starts to accumulate strain upon solidification. The reviewer wanted to know if there were any comparisons of theory with experiments on the thermo mechanical property predictions.

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 said that once again, it appears to be a very well organized and worthwhile piece of work that is making excellent progress. The reviewer added that further progress on the topic of these bimetallic joints could enable them to worm an essential component of the future MMLWV, which will be critical to making corporate average fuel economy standards and ensuring safe and durable vehicles.

Reviewer 2:

The reviewer commented that the residual stress has been measured and then modeled; some agreement has been observed between model and measured values. Also, the team has tried to develop a heat treatment cycle to improve the yield strength of the aluminum alloy. The reviewer wanted to know what the impact of this treatment was on the stress distribution. The reviewer asked what the impact

of heat treatment was on the interface structure. The reviewer added that in general the work is very simple characterization which had provided some data for simulation; however, more data is needed to improve the simulation capabilities.

Reviewer 3:
The reviewer remarked that the modeling work is very comprehensive. The reviewer asked why the project team meshed substantially triangular elements (these tend to stiffen the structure). The reviewer wanted to know why the project team did not use quads. The reviewer would like to see more comparisons with experimental data at the various modeling steps. The reviewer added that the example of experiment/theory of residual stresses is interesting even though there is a disparity between the two.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the team appears to be working smoothly and harmoniously, it seems that the program is making very effective use of the resources available.

Reviewer 2:
The reviewer pointed out that the collaboration is with a single partner. The reviewer added that it would help to draw in a potential end user of the technology being developed for advice on how to implement to mass produce parts.

Reviewer 3:
This reviewer observed that only one Tier 1 supplier is on the team. Also, the reviewer commented that CRADA restricts the dissemination of data. The reviewer pointed out that the actual contribution of the partner needs to be presented in dollar terms.

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 proposed future research was nicely presented and the future path seems logical and worthwhile.

Reviewer 2:
This reviewer indicated that this is the last year of the project and the plan for remaining fiscal year is good.

Reviewer 3:
The reviewer wanted to know if there are any plans to bundle up the computer codes and the experimental process parameters to give to someone who can use this information to make parts for vehicles.

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

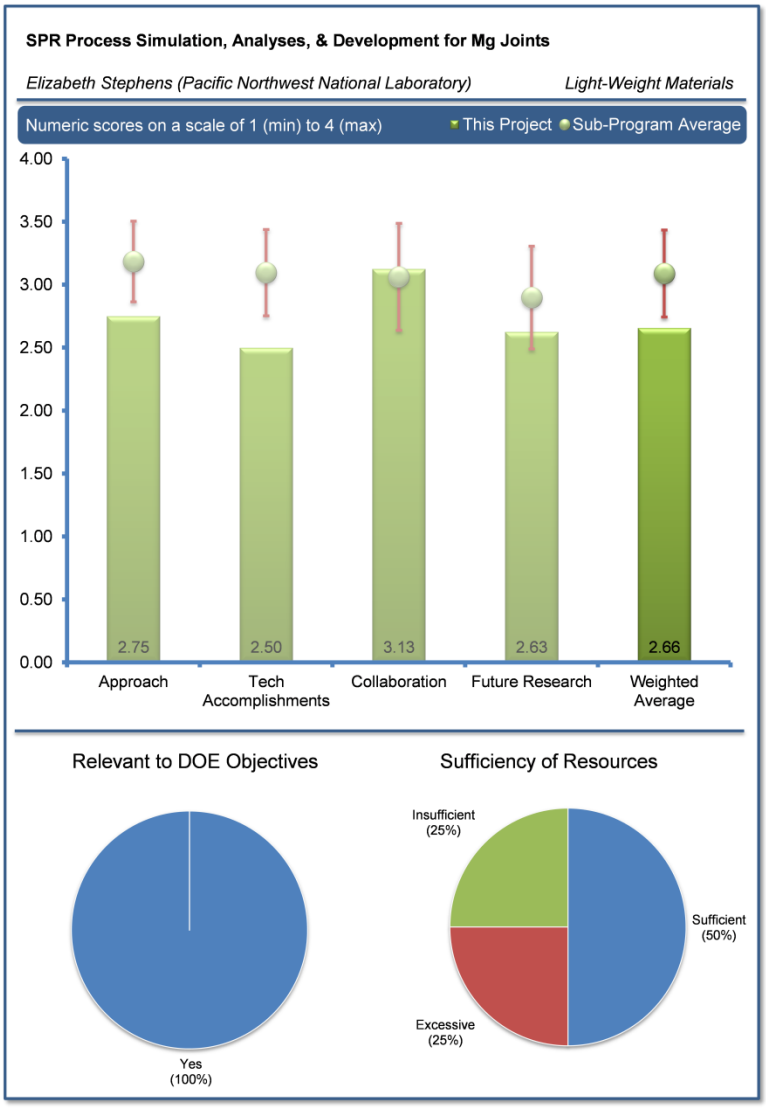
Reviewer 1:
The reviewer indicated that this work is fully aligned with vehicle light weighting goals which contribute directly to petroleum displacement.

Reviewer 2:
The reviewer asked if the PIs have discussed the proposed heat treatment process with any end user, for example, in the automotive industry.

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 funding appears to be fine and that there are no issues with funding.

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



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 the project team had a very pragmatic approach to surface plasmon resonance (SPR). The reviewer pointed out that the emphasis on the simulation tool development is the best part of the project. The reviewer added that while the process parameter determination based on empirical experiments is standard procedure within the industry for almost any process, the use of those experiments to validate the simulation results is the preferred method.

Reviewer 2:

The reviewer commented that the research appears to be creating a competitor for Bollhoff. The reviewer added that the approach does not include a new method or technology.

Reviewer 3:

The reviewer indicated that the thermal modelling could be valuable, if proven to be accurate; however, the current technique used to make the joint test coupons appears to be very empirical. The reviewer added that the heating system does not appear to have good control over the amount of heat generated in the test pieces, and there does not appear to be a way to accurately assess the temperature reached or the temperature of the sheet during the SPR process since the pieces are heated and then manually moved to the riveter.

Reviewer 4:

The reviewer stated that the methodology is good, but effort appears to be timid. The commenter voiced that this is important work that should be continued with wider applications and more resources.

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 project team has made good progress both on the simulation models, process development, and experimental validation. The reviewer added that the technical results seem to be consistent with other projects in the VTO Mg portfolio.

Reviewer 2:

This reviewer indicated that progress has been made in producing the induction heating coil, die modifications and testing a number of samples produced with various rivet and die combinations; however, that seems like work that did not require the skills of a national

laboratory to complete. The reviewer added that last year's report indicated that there was also work underway in modeling and optimizing mechanical crimping as well as SPR. That work was to be continued this year (as specified in last year's future work); however, the reviewer did not see or hear any mention of crimping in this year's report.

Reviewer 3:
The reviewer stated that the progress with respect to 2013 was significant.

Reviewer 4:
The reviewer commented that there was no benefit relative to existing commercially available technology from Bollhoff.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer indicated that there is clearly close collaboration between the industrial partner and PNNL, and this collaboration is the key to the project's success both technically as well as from a transition point of view. The reviewer did not see how it could be improved and the reviewer applauded the performers for working so well together.

Reviewer 2:
The reviewer stated that Stanley appears to be well engaged in all aspects of the project, as would be expected when there are only two entities involved in a project.

Reviewer 3:
The reviewer commented that there seems to be a positive working relationship between PNNL and Stanley. The reviewer added that there was no pathway to commercialization identified.

Reviewer 4:
The reviewer did not understand why the car industry is not involved in this 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:
The reviewer said that the most value will come from design guidelines and exploration of alternate rivet materials and interlayers and hopefully that will be emphasized.

Reviewer 2:
The reviewer indicated that the future work plan, as proposed, is the weak part of the project thus far and can be greatly improved. The reviewer recommends the proposer develop a more structured plan on how the team will utilize the virtual tool developed thus far to improve the process with regards to rivet materials, shape and so on. For example, will the tool be used in a designed experimental fashion to determine the optimal material parameters and then find an actual material that is close, or will a set of existing materials be used. If so, the reviewer asked how the materials will be selected. The reviewer also asked what the materials represent. The reviewer also wanted to know if the rivet geometry will undergo any topology optimization. The reviewer also asked how the optimization task will be formulated. Lastly, the reviewer commented that a great number of structured experiments with regards to crack formation were conducted, but these experiments were not statistically analyzed. The reviewer suggested that since these experiments represent a significant investment, that the data be statistically analyzed for additional insight, or further validation of functional relationships between input variables and crack development.

Reviewer 3:
The reviewer pointed out that it is the last year of the project. The commenter hoped that such a research will be continued with a much broader participation of the industry.

Reviewer 4:
The reviewer recommended to "put a bow on it" and to move on to other research areas.

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

Reviewer 1:
The reviewer remarked that identifying an effective joining method for Mg with regards to cost, cycle time, and performance is essential to use Mg in automotive.

Reviewer 2:
The reviewer agreed that any weight reduction is part of DOE's goal of petroleum displacement.

Reviewer 3:
The reviewer indicated that if successful, this project should enable more widespread application of Mg in reducing vehicle weight. The reviewer added that the relevance will ultimately be determined by how widely the information (e.g., user guide and design guide) are distributed and implemented.

Reviewer 4:
The reviewer explained that SPR technology is relevant but project goals do not address nor achieve a fuel savings relative to mass reduction.

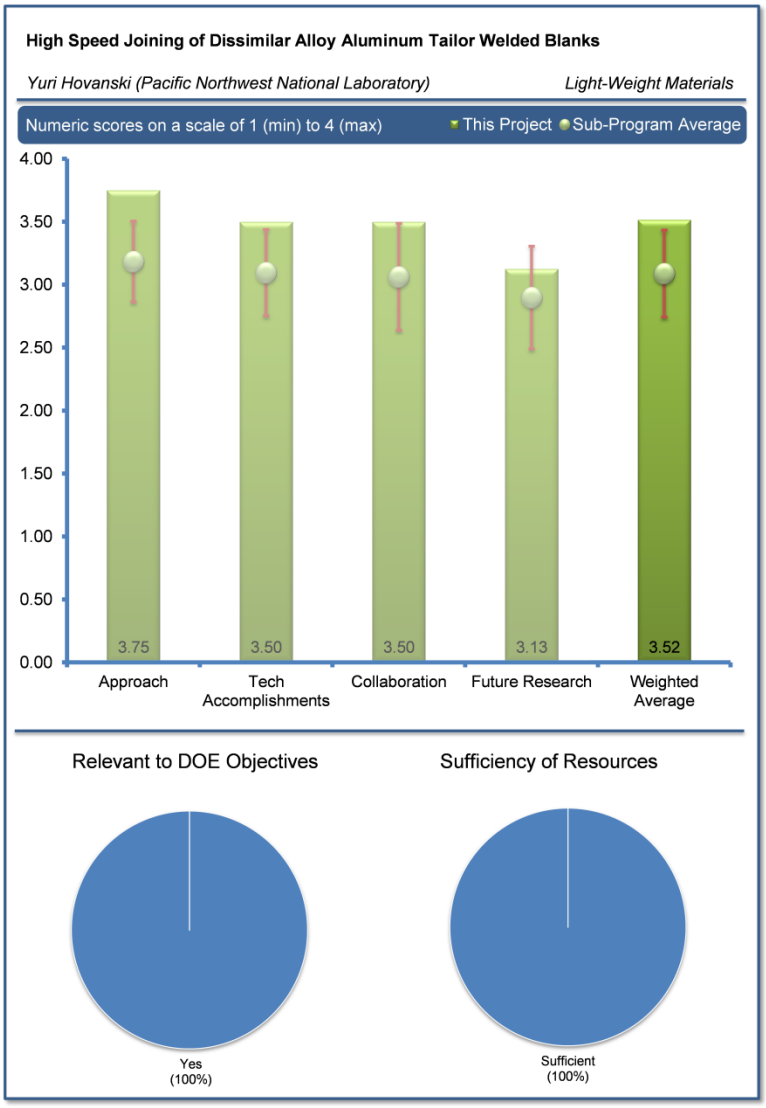
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
The reviewer stated that it appears the funding is sufficient thus far. The reviewer could see a situation where with the development of the virtual tool to determine the optimal process might require additional funding, but this might be a future effort or an additional effort under this project. At this time, the funding is sufficient.

Reviewer 2:
The reviewer indicated that the research effort did not provide tangible benefit, thus resources could have been deployed on other topics.

Reviewer 3:
The reviewer expressed that the effort appeared to be timid, like a preliminary research effort to something bigger.

High Speed Joining of Dissimilar Alloy Aluminum Tailor Welded Blanks: Yuri Hovanski (Pacific Northwest National Laboratory) - lm075



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 found this to be one of the most important development projects as an enabler for lower cost Al assemblies. The reviewer suggested keeping up the great work, especially scaling the larger process with tailor welded blanks (TWB) to further develop the friction welding process for high volume applications.

Reviewer 2:

The reviewer stated that this project was a great approach to prove-out Al TWB. The reviewer pointed out that the four tasks adequately address the barriers of development and implementation. The reviewer added that the efforts to investigate, evaluate then develop and prove out are great.

Reviewer 3:

The reviewer remarked that the project was well planned and executed; it met the original objectives of developing a solution for the TWB for Al sheet forming.

Reviewer 4:

The reviewer stated that the project has examined a range of joining technologies available for joining Al. The reviewer added that the project team produced coupons from each of these technologies. The reviewer stated that the friction stir processing was chosen as the method. The reviewer then asked if normalized main effects plots need to be generated for all Al alloys to be welded. The reviewer also wanted to know if these main effects plots need to be generated for each heat/lot, supplier (even if the alloy is the same). The reviewer also asked how many meters of TWB can be welded before the tool must be changed out.

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 design of experiments and the forming limit efforts have been outstanding. The systematic approach to the key parameters in friction stir welding has resulted in a robust design for the tool. The reviewer added that running at near production speeds has demonstrated the process. Also, the reviewer stated that the coupon testing and probabilistic forming limit diagram gives the design community what it needs to incorporate tailor welded blanks into components. The reviewer commented that the publication of The Minerals, Metals, and Materials Society (TMS) and Society of Automotive Engineers (SAE) papers was a great effort to disseminate the information.

Reviewer 2:
The reviewer said that the project was very detailed and focused on what we would develop if this were an industrial research project. The reviewer added well done.

Reviewer 3:
The reviewer stated that the welding process has been optimized to provide the TWB aluminum sheets; the whole gamut of the variables including tool materials, geometry, feed and speed and others were considered and studied in depth. Also, the reviewer pointed out that the joints were characterized and optimized. The reviewer added that the availability of TWB aluminum for further working is the validation for the project team.

Reviewer 4:
The reviewer asked what "high speed" means regarding the high speed welding development. The reviewer also wanted to know what the approach is to predicting weld failures. The reviewer asked what is meant by a weld failure, and if there has been experimental validation of FE model predictions of any bench scale test.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer commented that there was excellent collaboration with the auto company and weld producer along with materials supplier. The reviewer asked if the PIs are working to get these disparate groups to work together, communicate, share information, etc.

Reviewer 2:
The reviewer remarked that the project had an excellent scope and breadth of collaboration partners.

Reviewer 3:
The reviewer indicated that there was great vertical integration through the supply chain. The reviewer added that the partners all contribute to the project success.

Reviewer 4:
The reviewer stated that the project has developed a process supply chain for the TWB of aluminum; this is quite significant and will contribute to the faster implementation of the aluminum sheet technology in automotive structures.

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 indicated that moving to the 7xxx alloys is a good target and future direction; continue to focus on mixed aluminum products (i.e., 5xxx to 6xxx to 7xxx).

Reviewer 2:
The reviewer stated that the project is in the last year. The reviewer added that the plan for the remaining period is satisfactory. The reviewer stated that in future the coating and corrosion performance of the TWB sheets can be evaluated.

Reviewer 3:
The reviewer observed that it was unclear how the weld predictive design tools will be handed off to the OEMs. This must include some type of fracture prediction, but none has been discussed. The reviewer wanted to know if constitutive models of the FWS weld zones will be developed based upon the unique material properties in the weld zones.

Reviewer 4:
The reviewer commented that the single statement of 'Complete Technology Transfer,' with only two points beneath, was way too simplified. The reviewer had hoped to see more details on these plans. The reviewer added that hopefully the oral presentation would give more details.

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 is truly a lightweight enabler.

Reviewer 2:
The reviewer reported that having the flexibility to use Al tailor welded blanks for stampings will enable further light-weighting of body and closure stampings. The reviewer added that the reduced weight will displace petroleum use.

Reviewer 3:
The reviewer stated that Al is being used currently to meet the immediate energy efficiency. The reviewer added that more Al can be used if the process cost is reduced for wrought Al. The reviewer noted that this project has developed a technology for the sheet Al and it will increase the use of Al sheets in future vehicles.

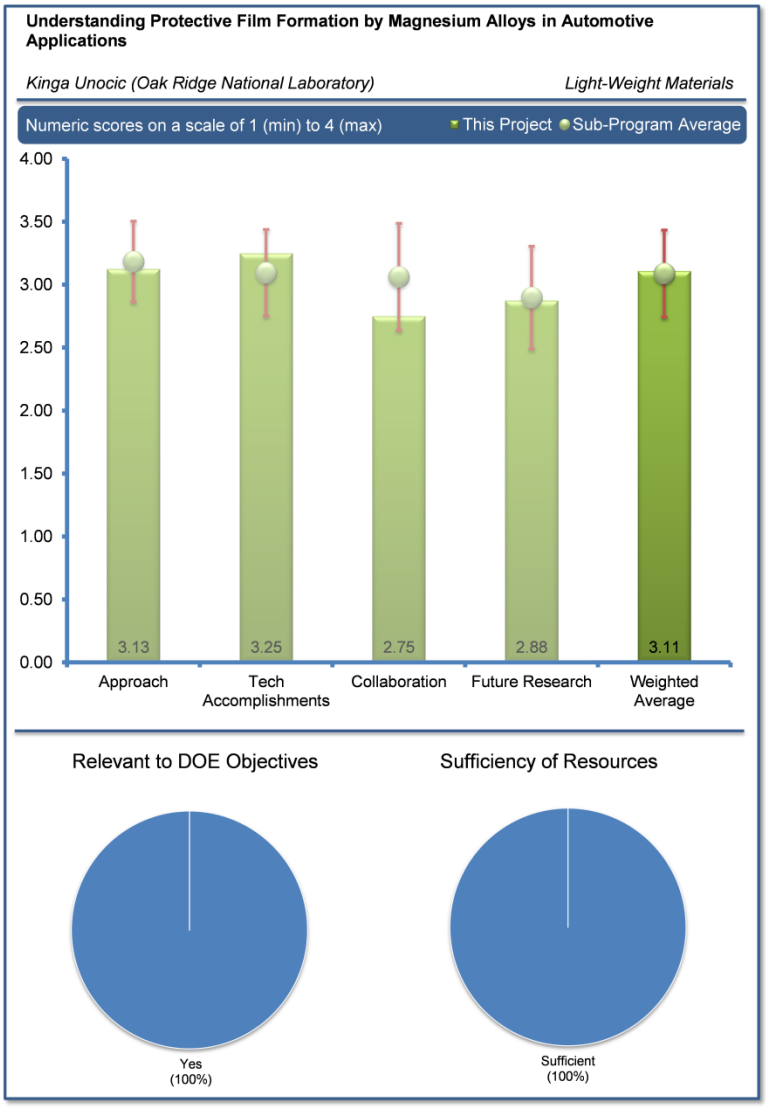
Reviewer 4:
The reviewer remarked that friction stir welding instrumentation is more costly than spot welding instrumentation. The reviewer wanted to know if the authors have considered this. The reviewer also asked how much friction stir welding is done in automotive manufacturing at the present time. The reviewer also asked if the component manufacturing and the availability of the TWBs is going to offset cost of installation of new friction stir welding joining equipment.

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

Reviewer 1:
The reviewer indicated that good progress indicates adequate resources.

Reviewer 2:
The reviewer said that the project was appropriately resourced and that no changes are needed going forward.

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



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 overall approach seems to be quite reasonable but the reviewer found the statement "milestones focused on publications" to be rather odd. The reviewer stated that effective commercial exploitation can be impaired by open publications (although the reviewer may have misunderstood this aspect of the approach and project aims). Overall, the reviewer would say that too much time was spent on the chemistry of the corrosion solutions and very detailed explanations of test results, while too little attention was given to what the results mean and how they affect applicability of the material to actual vehicle components.

Reviewer 2:

The reviewer indicated that this project had a strong characterization approach for understanding chemistry of films (corrosion) that develop on two Mg alloys (MgAZ31B and Neodymium (Nd)-bearing Mg). The reviewer wanted to know if the PI is sure that Nd actually diffuses. The reviewer stated that it seemed that the Nd solubility is very low.

Reviewer 3:

The reviewer mentioned that the surface condition of Mg was evaluated using various techniques. The reviewer added that two Mg alloys were evaluated and that the plan is good.

Reviewer 4:

The reviewer said that the project provided a very good academic study of Mg corrosion. The reviewer suggested that the project team continue to focus on bulk crystal structure corrosion and oxidative studies, but try to migrate to corrosion of grain boundaries and determine the corrosion rates at micro-cells typically found at GB and PPt where localized corrosion initiates.

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 said that this type of micro characterization is neither easy nor standard so keep up the good work and expand into other areas. The reviewer did like the thought of evaluating the Alodine 5200 and the various e-coat systems.

Reviewer 2:
The reviewer indicated that this project is using state-of-the art experimental methods to determine chemistry of films that develop two different Mg alloys. The reviewer added that secondary-ion mass spectrometry (SIMS) is particularly interesting, along with scanning electron microscope and X-ray photoelectron spectroscopy (XPS). Also, the reviewer stated that the PI presented many results, a single slide summarizing these results and their implications for manufacture of Mg alloys.

Reviewer 3:
The reviewer stated that the project appears to be making good progress in building an understanding of coating that form on magnesium, which will be crucial to applying this material to real-world components.

Reviewer 4:
The reviewer commented that the characterization involves exhaustive study of the Mg corroded surface using XPS, SIMS and other techniques. The reviewer also added that most of the time the findings are reported without making efforts to analyze the results and the significance of the findings.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the collaboration with BASF, Henkel, McMaster and others is noted; expand this effort to include industrial partners for more real world corrosion situations that are significant challenges.

Reviewer 2:
The reviewer would like to have seen some more detail on collaboration with Magnesium Elektron, University of Manitoba and McMaster University.

Reviewer 3:
This reviewer noted that only a material supplier and two universities are listed as collaborators. The reviewer added that for a basic research project this will be the minimum but not enough. The reviewer suggested that efforts should be made to discuss with other experts both academic and industrial ones.

Reviewer 4:
The reviewer remarked that the PIs need to think about what the project team can do with all of the information generated. For example, the reviewer asked if the project team has been in contact with any industry that may be a large-scale user of Mg, wherein corrosion is significant barrier towards wider scale implementation of Mg alloys.

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 good, solid studies, continued progress.

Reviewer 2:
The reviewer reported that more analysis is being proposed; also the effect of coating is being tested. The reviewer stated that if possible discussion with other experts should be initiated.

Reviewer 3:
The reviewer asked if there was any planned linkage with the theoretical modeling community. The reviewer commented that it seems that this project has developed a wealth of information that could benefit those in the theoretical community who are trying to model Mg corrosion. The reviewer wanted to know what is planned along these lines. The reviewer also asked what the project team considered about the corrosion at grain boundaries and precipitates.

Reviewer 4:
The reviewer stated that the project team had good focus on core issues but the reviewer would have appreciated a somewhat higher level treatment of future work. The reviewer observed that in the talk, there was a very strong focus on micro-photographs and detailed explanations of corrosion films that formed in various environments, but the reviewer would suggest bringing the project talk back to how these results relate to in-service corrosion (and thus, how commercialization will be affected). Having said that, the reviewer indicated that the talk was unfortunately cut short by the time limit and so perhaps the above comment would have been addressed by the latter portion of the talk which was not reviewed.

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

Reviewer 1:
The reviewer stated that enhancing our understanding of the performance of Mg in service is a critical element in how this material is applied to real components.

Reviewer 2:
The reviewer indicated that corrosion is a significant barrier towards wider scale implementation of wrought Mg alloys in a variety of industries. The reviewer pointed out that understanding the nature of corrosion files is an important first step towards developing strategies to minimize or eliminate this problem in future Mg alloy chemistry. The reviewer then asked if the conversion coatings being explored would be cost-prohibitive in mass-produced Mg components.

Reviewer 3:
The reviewer commented that this is basic research evaluating the corrosion mechanism of Mg alloys. The reviewer indicated that it is necessary to understand the corrosion of magnesium so that better protective mechanisms can be developed. The reviewer added that as magnesium is proposed as the potential material for weight saving improving its performance in service will accelerate its use in structures.

Reviewer 4:
The reviewer said that corrosion protection and mitigation is still an important element of implementing Mg for automotive applications.

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

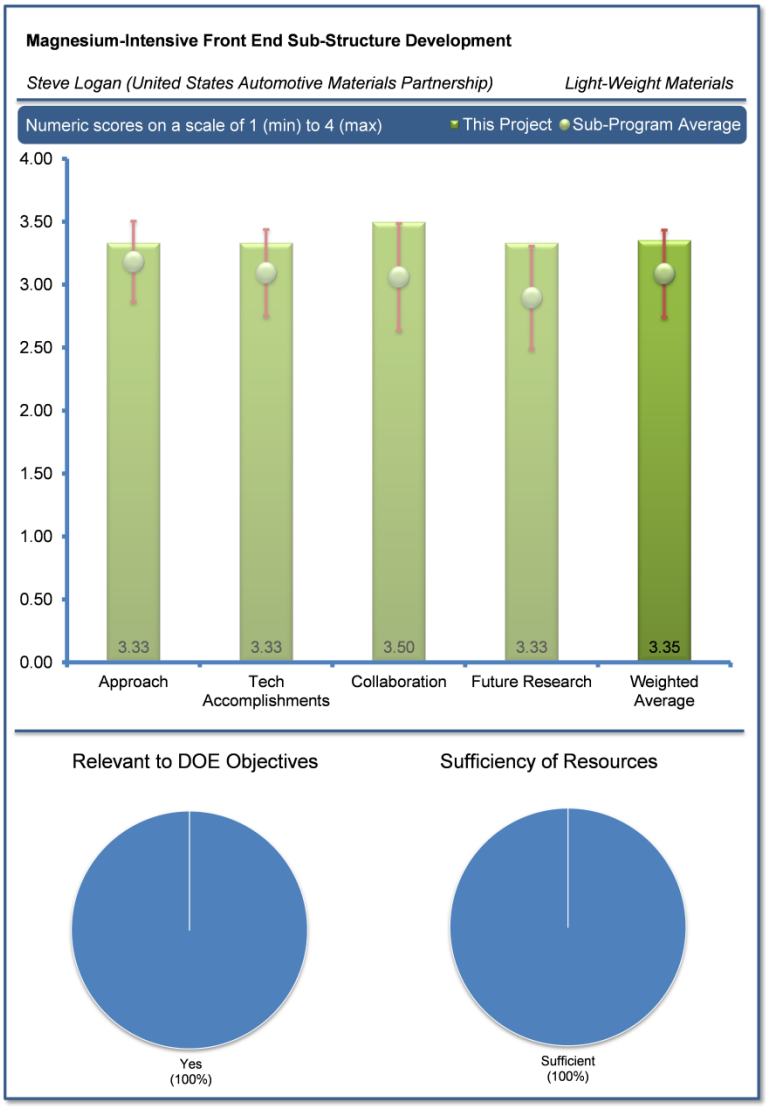
Reviewer 1:
The reviewer said that the funding seemed okay.

Reviewer 2:
The reviewer asked where all of the data is being generated in this project being collected. The reviewer wanted to know if there is a SharePoint site somewhere that can be accessed by those in the technical community who may need the data. The reviewer also asked if all of the data will only be available in various publications. The reviewer asked if the PIs have communicated with Mg material suppliers to discuss possible changes in processing to minimize or even eliminate corrosion effects in their materials.

Reviewer 3:

The reviewer indicated that the project is appropriately funded, maybe a little on the high side.

Magnesium-Intensive Front End Sub-Structure Development: Steve Logan (United States Automotive Materials Partnership) - lm077



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 said the approach is a pragmatic empirical approach. The reviewer added that it sacrifices scientific generalizability for industrial transition ability. It also mixes several research issues as follows: new material development and evaluation; joining of dissimilar materials; and design, modeling, and forming of Mg casting. The reviewer stated that the advantage of this approach is all three tasks are relevant to industry adoption and reflect the major issues the industry would face to adopt Mg. The results should indicate where existing gaps to commercial adoption exist. The reviewer also remarked that it is unclear the degree to which the results and methods will be generalizable to other areas of a vehicle.

Reviewer 2:

The reviewer indicated that this appears to be a huge project with as many project management challenges as technical ones. Also, the reviewer said that there is a genuine concern that so many unique applications on a single test configuration may result in some unusual failure mode that will mask the true performance of the Mg structure. The reviewer added that while it is appropriate to consider the joining, coating, and extruding it really complicates the study. The reviewer observed that given the growth in Al body-in-white structures this year Mg will really be challenged by the OEMs in those structures.

Reviewer 3:

The reviewer explained that this is generally an important project, with broad potential applications and particularly for the car industry. This time, however, the reviewer did not have the impression of a strong drive towards meeting DOE's goals, but rather, and even though work is progressing, of a time of reflection, some kind of a pause. The reviewer asked for a confirmation or explanation of these observations.

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 commented that the team has been very active and has made excellent progress towards their goal (completed design, created ICME models of joints with joining processes, conducted a variety of experiments in load, shear, fatigue, and corrosion to

validate ICME models). That said, the reviewer remarked that the project team has recognized major issues that still need to be addressed (corrosion and joining, fatigue performance). Whether the team is going to be successful is an open question.

Reviewer 2:
The reviewer stated that the cracks in the free castings from Canmet show the complexity of this project. The reviewer assumed one could study shock town designs for some time before properly optimizing for both manufacturing and in vehicle performance. The reviewer would be concerned if the final structure testing highlights an area known to be a problem in manufacturing rather than accurately demonstrating the performance of the material in this application. The reviewer added that this is definitely a tradeoff when working on only demonstration parts rather than on an actual vehicle program with full vehicle validation efforts.

Reviewer 3:
The reviewer thought that there was some fatigue among the participants of this large program. The commenter hoped that participants will regroup and find a new wind.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer emphasized that it looks like a monumental task to keep all the involved agencies and supplier partners working to the same objective.

Reviewer 2:
The reviewer noted that on a project of this size coordinating with multiple countries, close collaboration between everyone is not necessary, cost effective, nor manageable. The reviewer cautioned that the key is to have clearly defined roles and responsibilities and ensuring everyone meets their co-dependent deliverables on time. Further, the reviewer said that clear communication between those organizations that are tightly coupled in their work is essential, but that degree of communication is not necessary across the entire group. This reviewer believes the collaboration between the performers is appropriate and excellent based on the results presented thus far.

Reviewer 3:
The reviewer noted that yes there was collaboration, but suggested that it would be better if Europeans would be included in such a large project. On the other hand, the reviewer acknowledged that the participation, as it stands, may be too large already.

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 is moving along and the future work addresses the plan. Although acknowledged in the presentation and the slides, this reviewer is concerned with the remaining technical barriers that have not been successfully resolved (corrosion, joining, high performance casting). Specifically, this reviewer would have preferred to see a plan on how these technical barriers would be addressed with a potential risk assessment and abatement plan for the rest of the project over the future work that was presented. The future work was generic and not focused on the technical barriers.

Reviewer 2:
The reviewer commented that it may be difficult to get all the work completed by the mid-2015 target completion date.

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

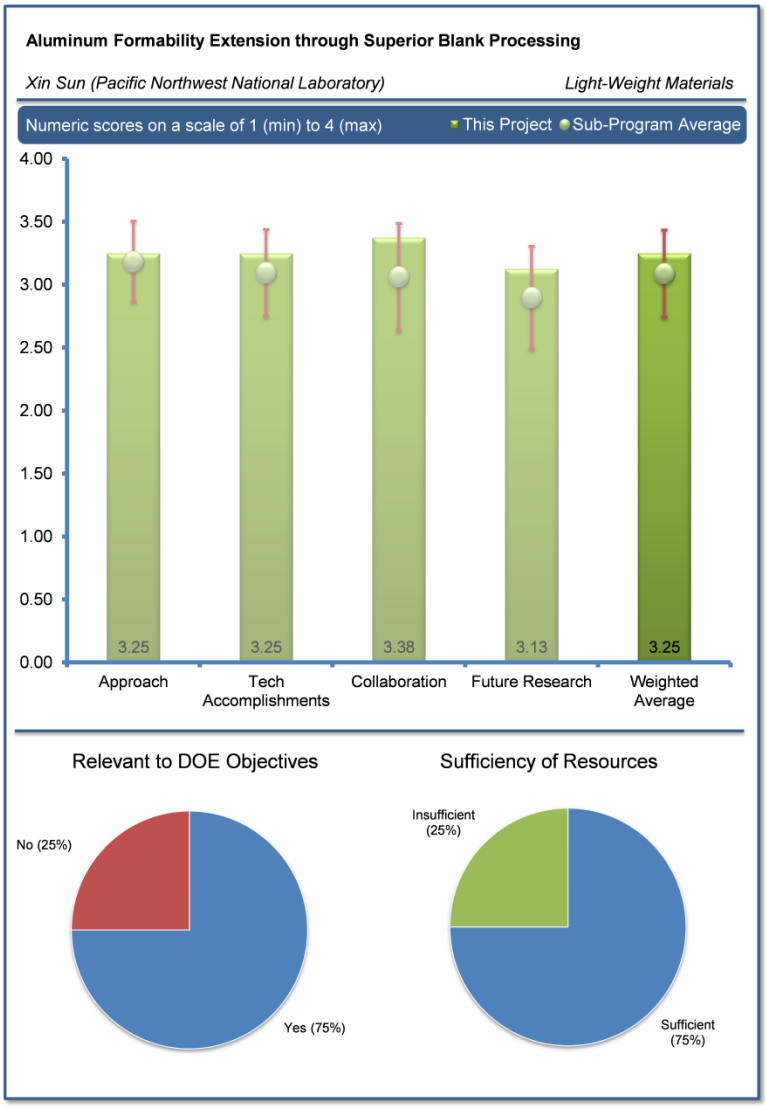
Reviewer 1:
The reviewer indicated that this project is extremely important in addressing at a systems level the issues that an OEM may face in dealing with integrating advanced, crash critical Mg castings into a multi-material structure. The reviewer added that the variety of technical challenges from modeling, through forming, and joining are becoming clearer and will help focus future research investments.

Reviewer 2:
The reviewer remarked that it is not a super strong relationship between Mg and petroleum displacement, but this demonstration may provide the necessary validation for use in future vehicle platforms.

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 the resources to complete the plan are sufficient. The reviewer added that given the barriers and technical challenges, the project may not be "successful" in resolving all the remaining technical barriers. Also, the reviewer said in this case future resources focused on overcoming those barriers may be necessary.

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



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 reported that the project appears to effectively integrate modeling and experimentation to develop and validate models that should shorten future process developments.

Reviewer 2:

The reviewer explained that the approach is a good and common applied research project. The reviewer suggested that the project team conduct a literature review, collect data to determine the nature and magnitude of the problem (potentially developing new metrics), conduct engineering analysis/simulation to controlling variables that appear to be relevant, conduct experiments to validate the simulation results, develop new process based on the new validated understanding of cause and effects, construct process and experimentally validate the process performs as predicted. The reviewer pointed out that the presenter claimed the approach is different. It may be different than some industry trial and error processes (which are becoming rarer even in industry), but it is and has not been, an uncommon approach in research/industry projects. The reviewer explained that within the limits of the project (material type, stamping based trim processes) the research is sound. The results are likely not generalizable beyond the limits mentioned. That said, the reviewer stated the methodology and metrics developed here will accelerate the analysis of trim operations with other materials, such as third-generation (3G) AHSS and Mg sheet.

Reviewer 3:

The reviewer said that the project goals are investigative and do not include potential product application to realize DOE goals.

Reviewer 4:

The reviewer inquired about how the sheet preparation process, if critical, could be implemented at a reasonable cost in factory floors. To this person, the criticality of the preparation process goes against production improvements; one part of the research is missing here.

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 expressed that the results are very significant and will help the industry.

Reviewer 2:
The reviewer stated that there was good progress on achieving goals and understanding of high rate forming.

Reviewer 3:
The reviewer noted that a lot of experimental and analytical progress (including development for measuring safe/fail strains) has been made.

Reviewer 4:
The reviewer indicated that the technical results are good. The reviewer added that the Oakland University method for generating the large strain rate curves was innovative. Also, the reviewer said that the experimental validation of the finite element analysis results is notable and closer than many other similar experiments the reviewer has seen in other projects. Ford's fluid dynamics (FLD) map for trimming is also interesting, albeit completely empirically based and difficult to generalize.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that there appears to be a close working relationship and integration of efforts between PNNL, Ford and OU.

Reviewer 2:
The reviewer agreed the collaboration is good, but cautioned that it is too limited.

Reviewer 3:
This reviewer is concerned that Ford's work is in direct competition with the PNNL modeling work. They seem to be different approaches to attack the same problem. During the Question and Answer (Q&A) period, the reviewer was gratified to learn that PNNL was able to duplicate the results with their ICME models. The reviewer commented that this means they now have developed a process that could be generalized to trim operations for other metals that results in validated FLD like diagrams that are operationally useful. The reviewer stated that this is perhaps one of the most significant outcomes of the 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:
The reviewer stated that the future work is straightforward completion of the project. The reviewer does not see any major issues of concern.

Reviewer 2:
The reviewer indicated that future plans address work that needs to be finished to bring the project to a reasonable conclusion; however, dissemination of the information should be explicitly stated in the future plans list (even though recognition of its importance is implied).

Reviewer 3:
The reviewer pointed out that this is the end of the project, but the reviewer hoped that it will be continued with a better integration of the process into the factory floor.

Reviewer 4:
This reviewer said that the project is in sunset phase.

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

Reviewer 1:
The reviewer claimed that improved stamping of Al would enable more widespread use of Al in reducing the weight of vehicles.

Reviewer 2:
The reviewer agreed the project purpose has the potential of helping reduce the weight of vehicles.

Reviewer 3:
The reviewer said yes, with reservation. The reviewer reported that the application to Al shows that the Al team is improving the quality of Al stampings, which will increase the adoption of aluminum. This reviewer does not have sufficient insight to determine whether trimming is a major bottleneck over other quality or manufacturing issues, such as joining or corrosion. In other words, the reviewer asked will improving the trim quality of Al sheet yield an increase in Al use, or are the other barriers, such as steel to Al joining or the cost of Al sheet, the reasons that really keeps Al out of vehicles.

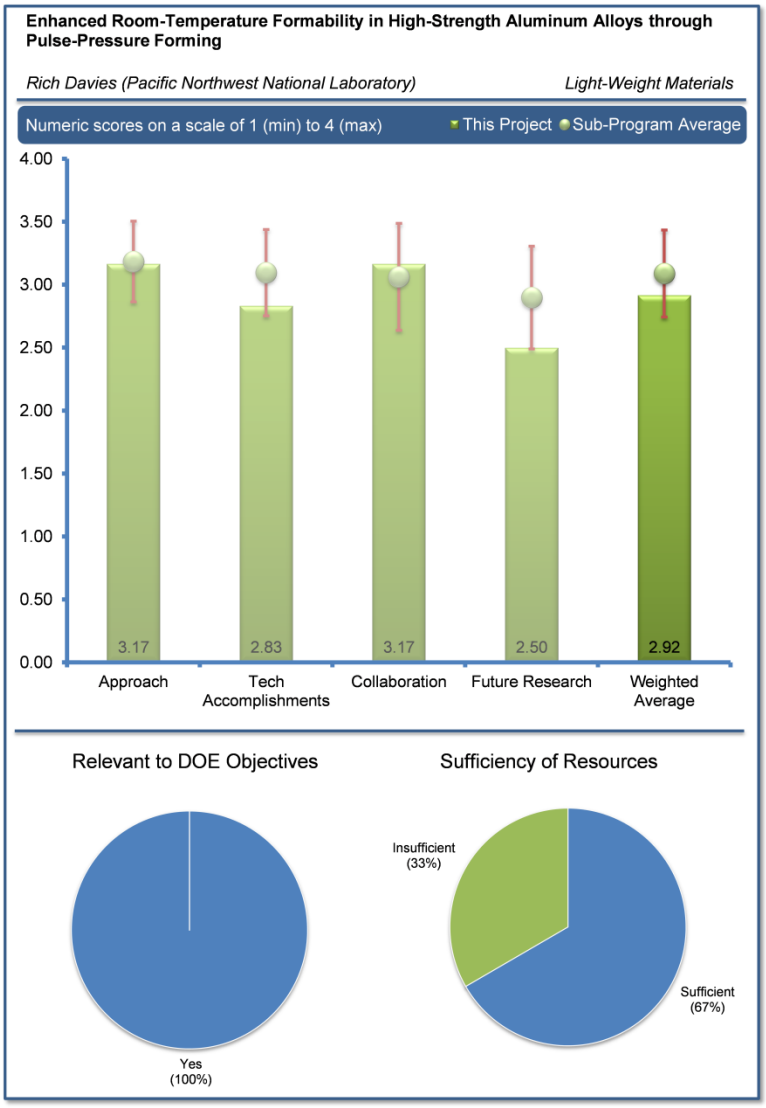
Reviewer 4:
The reviewer said that the project does not provide tangible application to realize fuel savings.

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

Reviewer 1:
The reviewer said that resources are sufficient. The reviewer added that Ford's increase in cost share is a sign of industrial acceptance and project success.

Reviewer 2:
The reviewer asked if the sheet preparation process was critical, then how could it be implemented at a reasonable cost in factory floors. To this person, the criticality of the preparation process goes against production improvements; one part of the research is missing here.

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 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 said that the approach is straightforward and appropriate for this project. The reviewer added that starting from readily available material grades and gauges that are typical for automotive components gives the project a strong chance of acceptance if the goals are achieved. The reviewer stated that the novel experimental techniques and material characterization are valuable results from this work.

Reviewer 2:

The reviewer indicated that the room temperature formability of Al sheet alloys was investigated. The reviewer added that the work plan is good and all the variables are taken care of. Also, the reviewer recounted that the metallurgical factor, effect of precipitates and micro structure, is not studied in detail; however, the project has produced enough results to transfer the technology to the next step.

Reviewer 3:

The reviewer asked if the electro-hydraulic forming process is limited to small parts (e.g., cups, vehicle trim, etc.). The reviewer wanted to know if the electro-hydraulic forming process could be used to make structural components b-pillars and rockers, or closures such as doors, hoods and deck lids. The reviewer also noted 0.14 post-deformation strains for Al alloy 7075 may limit this process to specific parts. The reviewer said that there are different methods for measuring failure strains in forming limit curves using DIC. The reviewer asked what technique has been used here and why.

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 recounted that various aluminum alloys, 5xxx, 6xxx and 7xxx were evaluated. The reviewer stated that this provides a comparison on the capability of the process and makes it easier for the companies to see the advantages. The reviewer added that the experimental method and the analysis are well planned and executed.

Reviewer 2:
The reviewer indicated that the forming technique appears to be work as well as DIC method with high speed cameras for deformation measurement at strain rates in excess of 2000/s.

Reviewer 3:
The reviewer stated that for the past year the accomplishments are satisfactory. The reviewer was concerned that the project was extended from a third quarter 2013 finish date reported in the 2013 AMR to the current third quarter 2015 reported this year. Overall, the reviewer said that there appears to have been only a bit of work reported on 7075.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer indicated that the project had good direction from an OEM, material from Alcoa, and interaction with American Trim.

Reviewer 2:
The reviewer recounted that there was good collaboration with General Motors and American Trim. The collaboration with Alcoa was unclear. The reviewer would be surprised if Alcoa does not already have stress-strain data and constitutive relations for 7075.

Reviewer 3:
The reviewer pointed out that the supply chain is involved with the OEM, part manufacturer and the research institution. The reviewer added that if the commercialization efforts are successful, then it can be used by many more companies.

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 commercialization is the proposed future work and it is good that the project is paving way for more commercial use.

Reviewer 2:
The reviewer wanted to know if the material models can be implemented into commercial CAE codes, accounting for the rate effects in the Al alloys of interact, be generated and validated in this project. Also, the reviewer stated that costs associated with scale up of the electro forming process are likely to be quite high. This reviewer asked whether these costs would outweigh the benefits of forming Al at room temperature, and lead to standard room temperature of steel stamping remaining the best solution. The reviewer added that it may be the case that automotive OEMs will simply buy electro-pulse formed parts from a supplier (as is the case for hot stamped steels).

Reviewer 3:
The reviewer indicated that the plans are vague to achieve Milestones 5 and 6. Also, the reviewer is concerned that there is not more effort on more realistic part geometries. Finally, the reviewer said that the limited discussion of the path to commercialization is troubling. The reviewer then asked what path to production the project team sees with GM and American Trim.

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

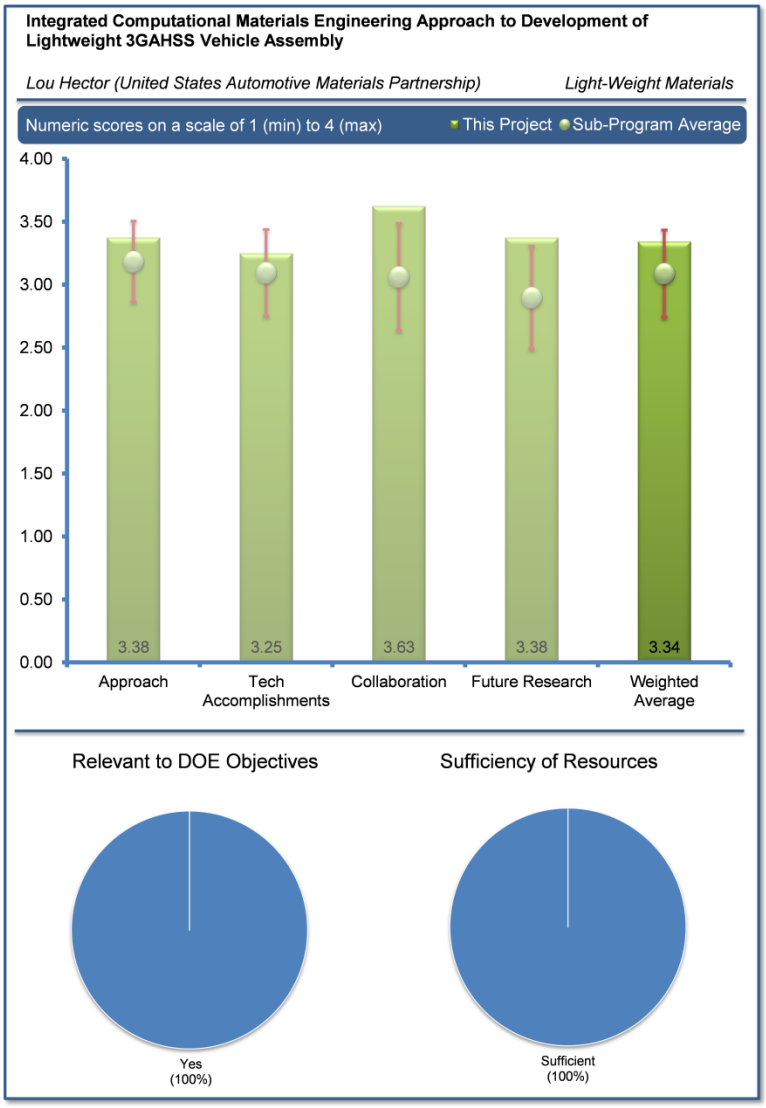
Reviewer 1:
The reviewer commented that Al is widely used in current vehicles and its role will increase to meet the fuel efficiency standards in the near term. The reviewer added that to make Al more attractive to vehicle manufacturers it is necessary to improve the wrought alloy forming especially high strength alloys. Also, the reviewer stated that these alloys are currently processed at high temperatures and the cost is high. Reducing the process temperatures will be a good strategy to reduce the cost.

Reviewer 2:
The reviewer indicated that if high strength Al can be formed at room temperature it will be more readily used in vehicles, thus saving weight.

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 the project end delay and limited results from FY 2013 might indicate a lack of resources.

Integrated Computational Materials Engineering Approach to Development of Lightweight 3GAHSS Vehicle Assembly: Lou Hector (United States Automotive Materials Partnership) - 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:

The reviewer stated that this project appears to be an excellent effort on an important problem. The reviewer commented that the group includes the right people and organizations. The project appears to be well designed and thought through and looks to be making strong progress. The reviewer added that the key thing now is to get adequate supplies of these new 3G steels into the supply chain to enable their widespread adoption in real parts.

Reviewer 2:

The reviewer indicated that the project has just been initiated; the work plan as presented is reasonable but involves many players and multi-level tasks. The communications and the feedback are important for the project to move in a smooth manner. The reviewer added that the presentation provides the pathway forward and it is reasonable to assume the progress will be made.

Reviewer 3:

The reviewer applauded the team for selecting the correct program metrics, namely percent accuracy (ICME models), weight reduction and cost (material development). Also, the scope to include the variety of material models and the empirical validation is excellent. The reviewer noted, however, that the weight reduction and cost goals are confounded with the specific design and questions the degree to which these targets can be reproduced in other areas of the body. The reviewer also lauded the use of a large number of research institutions to develop the models. While the communication burden is great, and some of these institutions have duplicative capabilities, the massive parallel model development effort is the key to achieving the aggressive program goals in such a short time frame. One point of clarification regarding Task 4 is needed. On Slide 8, Task 4 is an assembly and joining task, presumably of the different body components and addresses the weld-ability of the 3G AHSS; however, on Slide 9 it appeared Task 4 is primarily about assembly and integration of the various ICME models, which will only include forming and not include welding or other joining processes. Further the reviewer added that on Slide 11 there is reference to assembly and joining processes in reference to Tasks 5 and 7. The reviewer asked that the team please clarify Task 4 as well as the assembly and joining processes of the body components (not ICME models) and make the slides consistent. The reviewer's impression is that Slides 9 and 11 are more accurate and Slide 8 is a bit misleading.

Reviewer 4:
The reviewer agreed that this is a good and important project; however, the reviewer found the approach of Slide 10 to be too complicated. The commenter proposed that the project would be better served by having a more straightforward approach slide. The commenter agreed that the strategy of where these new AHSS's fit within the grand scheme of things for the auto-industry, so deserves a slide with specs (e.g., physical properties, chemical properties, desired time for implementation) and the corresponding estimated weight saving. The reviewer remarked that time estimates for certification were missing although the reviewer also explained that every factory will run its own suite of tests before using a new material. The commenter noted that heats were mentioned during the presentation, but asked what kind of heat size, laboratory size, intermediate (as there could be several steps used), and/or industrial size. The reviewer highlighted that each size presents its own series of thermodynamic problems.

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 had no criticisms or comments, all seemed to be going well.

Reviewer 2:
The reviewer indicated that very good progress was achieved between Year 1 and Year 2 of the project.

Reviewer 3:
The reviewer stated that given the relatively short time of the review (less than eight months of effort) and that a significant amount of time must have been spent on executing and improving the communication process, the technical accomplishments are excellent. The reviewer added that the project team has mostly revolved around using the existing models and technical expertise of the various research institutions to parameterize the QP980 baseline material. Also, the reviewer indicated that it would have been nice to see some example of how this characterization could be used to understand formability modeling to provide a preview of what is to come. The reviewer requested an update for next year on progress to prediction uncertainty of the ICME models (goal is 15%) and a risk assessment as to whether the project team will be able to meet that goal.

Reviewer 4:
The reviewer stated that during the first year of the project, which is only six months long, the project team and tasks were put together; the objectives are well planned and the role of project teams are defined. The reviewer indicated that with the actual work that has begun only in the second year the progress can only be assessed in next review.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the project seems to be making good use of the collaborations and relationships among the participants.

Reviewer 2:
The reviewer observed that the team is well represented by the various stakeholders whose work is well integrated with the roles of each stakeholder are well defined.

Reviewer 3:
The reviewer asked whether foreign participation was considered.

Reviewer 4:
The reviewer noted that the initial coordination appears to be going well. Given the amount of funding executed thus far, the reviewer suspects there were some initial hiccups in operationalizing the planned communication and that there will be significant improvement as the project progresses, especially as the development of the models progresses and the interdependence of the modeling effort between the institution increases. Also, the reviewer said that the major metric will be the degree to which the project remains on schedule and budget. The reviewer added that poor communication will likely result in delays and under budget performance.

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 there was a very nice presentation on this aspect of the project.

Reviewer 2:
The reviewer indicated that the selection of two alloys is a good start. Also, the reviewer commented that the development of new models to predict the microstructure and performance is important.

Reviewer 3:
For the future work, the reviewer suspects some of the Tasks are with respect to the new 3GAHSS and others are with respect to the QP9980. Specifically, validation of the fracture and forming models do not specify which material models will be validated. Further, there is no mention as to any potential concerns with regards to "extrapolating" from the QP980 to the new material models. This reviewer would like a bit more clarification on the technical barriers expected in the future work and any risk mitigation plan, as opposed simply a list of tasks and targets from the proposal. This is a highly ambitious, important, complex, valuable, and expensive project. It deserves critical scrutiny at a greater level of technical detail. This reviewer suggested adding the technical detail slide and during the AMR focusing on the technical and glossing over the task detail slide.

Reviewer 4:
The reviewer would like the approach to be revisited.

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

Reviewer 1:
The reviewer strongly stated that of course the project addresses DOE's goals.

Reviewer 2:
The reviewer pointed out that this work is highly relevant and central to DOE VTO goals. The ambitious nature of the project is to really shorten the time from material development to implementation through the use of ICME tools. The reviewer stated that this project may become a model for future material development work, and concluded that it is really quite astonishing.

Reviewer 3:
The reviewer remarked that given the cost issues and property/manufacturability challenges with most, if not all of the non-traditional automotive materials (e.g., Al, Mg, and CF), it is virtually certain that high performance steels will continue to be a vital material for vehicle structures. For that reason, the reviewer indicated that work on new advanced alloys of steel is extremely important and is of absolute central importance to the DOE objectives.

Reviewer 4:
The reviewer indicated that AHSS are important for the weight reduction of the vehicles without compromising the safety. The reviewer added that the development of these new alloys will contribute to the knowledge.

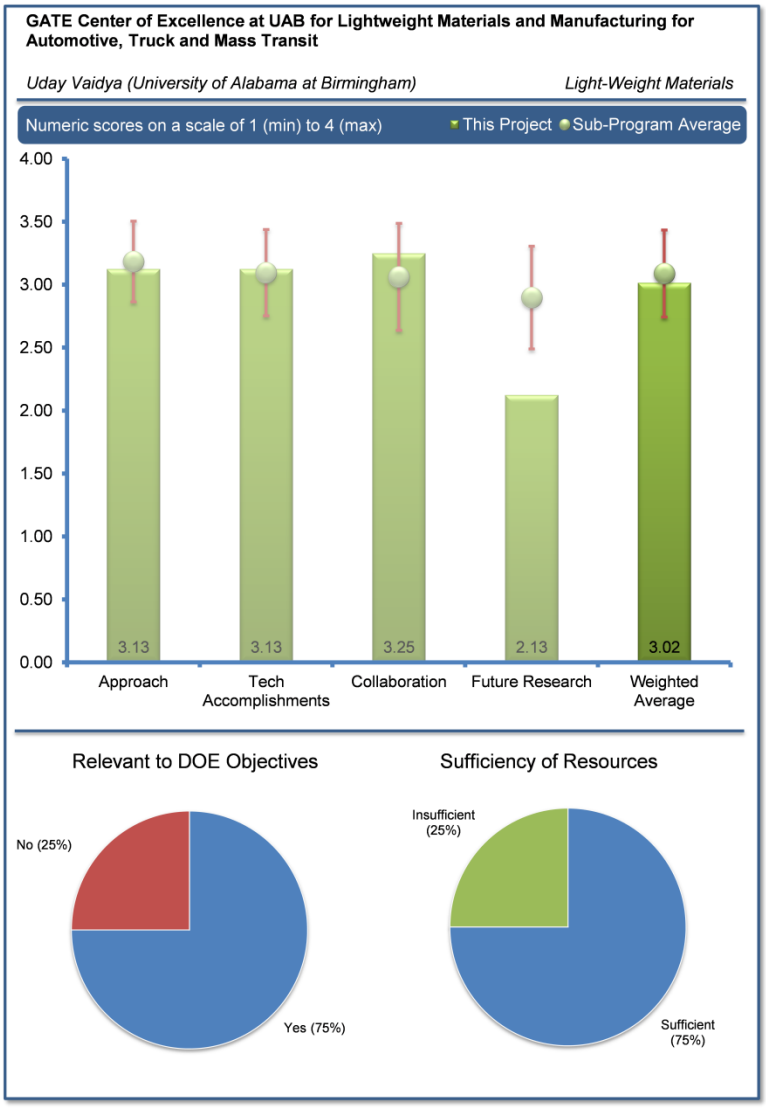
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
The reviewer cautioned that it is too early to say whether the resources are excessive or sufficient. This reviewer has already discussed the low burn rate and the potential difficulties that may delay the project or result in a reduced burn rate. If significant technical difficulties arise, then costs could increase. But, frankly with the caliber of brainpower the Auto/Steel Partnership has assembled, this reviewer finds this scenario to be unlikely.

Reviewer 2:
The reviewer said that resources appear to be okay.

Reviewer 3:
The reviewer explained that it really depends on the size and the number of heats, which they did not see any relevant indications of.

GATE Center of Excellence at UAB for Lightweight Materials and Manufacturing for Automotive, Truck and Mass Transit: Uday Vaidya (University of Alabama at Birmingham) - lm081



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 it appears that the work of this program is clearly focused on applications and skills development with rapid transition to industry.

Reviewer 2:

The reviewer recounted that the program is an educational program in automotive lightweighting with a variety of research projects that appear to operate as a graduate level co-op like experience. The reviewer added that the approach is fairly straightforward, although not particularly innovative. University of Alabama-Birmingham (UAB) is leveraging other investments, for example the National Science Foundation (NSF) quite effectively. The reviewer's major criticism is that the barriers mentioned on Slide 2 have no bearing on the stated program goals listed on Slide 3.

Reviewer 3:

The reviewer indicated that the little seed money project for a few students a year is a satisfactory approach to increasing the GATE efforts. The reviewer added that the efforts for education, while worthwhile, are difficult to defend as reducing petroleum use.

Reviewer 4:

The reviewer said that it is difficult to put this educational program on the same footing of the technical programs. It appeared to the commenter to be a very good higher educational program that was tailored to the automotive industry, which is particularly well-represented in Alabama. The emphasis seemed to be primarily on carbon fibers composites. The reviewer understood that the University of Alabama has limits as to what it can offer to students but, in the reviewer's mind, this was somewhat too restrictive.

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 there was good progress in teaching students in areas of interest and importance to the automotive industry.

Reviewer 2:
The reviewer stated that the technical accomplishments, in terms of the numbers of graduate students and the quality of the research, are satisfactory. The reviewer added that there appears to be little leveraged funding for GATE students from the Alabama auto companies. If these exist, example projects should be outlined.

Reviewer 3:
The reviewer indicated that the educational side has improved (more students, new course). The reviewer pointed out that the project team needs to update student graphs. Student support and participation is qualitatively explained and targets exceeded. There are no quantitative research targets, although much of the presentation focuses on the research. The reviewer thought it was unclear how the research projects are developed and selected or transitioned. The reviewer remarked that it was difficult to assess how the research projects fit together, if at all. The reviewer said that it was difficult to understand whether the university is also receiving funding from the supporting companies/organizations. The major positive accomplishment that is excellent is the shift in focus on external partnerships, which was lacking in the FY 2013 review. This reviewer would like to see more on the educational side and less on the research side. Specifically, the reviewer asked if this is a program to create the next generation workforce in vehicle light weighting, what is the institution doing to grow the program beyond VTO funding. The reviewer wanted to know how satisfied the employers are and if the graduates are really doing lightweighting work at their current employer or are they simply hired because they are good students to meet some other engineering need.

Reviewer 4:
The reviewer stated that it was difficult to put the technical accomplishments on the same footing as that of technical programs. For example, the reviewer inquired about how graduating 5 of 10 students would be perceived (e.g., outstanding, excellent, good, etc.).

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that there was very good integration with the ORNL CFTF and a number of commercial firms that sponsor students.

Reviewer 2:
The reviewer highlighted that the University of Alabama is lucky to be in the middle of such a concentration of automakers.

Reviewer 3:
The reviewer said kudos to the team for engaging community colleges, ORNL, and industry. The reviewer was surprised it was not more prominent in FY 2013. The reviewer stated that the degree of interaction is still a bit unclear. The reviewer wanted to know if the students work at ORNL, also the reviewer wanted to know if ORNL is simply making the CF. The reviewer asked what exposure the students get to the partners. The reviewer stated that internships are an effective model. The reviewer wondered if GATE requires co-op/internships. The nature of the industry interaction (funding, student-industry interaction metrics, degree to which the industry engages, adopts solution, benefits, etc.) for this program is, in this reviewer's opinion, more important than the specific research results.

Reviewer 4:
The reviewer pointed out that there were lots of logos on the slide but little evidence reported of outside companies, suppliers or national laboratory support. Advisory board meetings are little but not great collaboration. The reviewer stated that briefings to OEMs are far from 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 stated that the proposed future research appears to be continuation of current activities.

Reviewer 2:
The reviewer indicated that there appears to be little evidence of future plans to accelerate and expand the program.

Reviewer 3:
The reviewer reinforced that carbon fibers composites are not the only thing in lightweighting

Reviewer 4:
The reviewer stated that the proposed future research was not presented, the future plans are unclear. Given the significant change between FY 2013 and FY 2014 regarding industrial participation, this reviewer believes that the UAB team has future plans, but has not presented them regarding research or the education program or the overall GATE program through FY 2016. The reviewer asked if there are plans for future growth and student attraction. The reviewer also asked if the research plan has any strategy or if it is purely opportunistic and driven by some ad-hoc industrial need. The reviewer added that in the Q&A the student retention and attraction question, although stated as part of the DOE GATE program is apparently funded through the NSF and other programs. This is good, but this reviewer would like to see more about how the performer is planning on meeting or exceeding the program goal of "To provide a new generation of engineers and scientists with knowledge and skills in advanced automotive technologies." The reviewer wanted to know what the plans are to increase student participation at the undergraduate and graduate level. The reviewer also asked what the future plans are with regards to curriculum development. Additionally, the reviewer asked what the plans are regarding expanding industry collaboration and leverage. The reviewer also wanted to know where the risks are and what metrics are being collected to help UAB figure out how to improve (as opposed to simply "satisfy" DOE reporting requirements). The specific research objectives, in this reviewer's opinion, while interesting and indicative of the quality of the work, are simply not important as "future work" goals.

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

Reviewer 1:
The reviewer stated that increasing the number of engineers capable of designing and manufacturing automotive systems with new lightweight materials contributes to the commercial adoption of these materials the DOE goal of lightening vehicles to decrease petroleum use.

Reviewer 2:
The reviewer commented that it is crucial for the automotive and transportation industry to have talented engineers and researchers from diverse backgrounds trained in technologies that are important for vehicle lightweighting.

Reviewer 3:
The reviewer simply stated that the project definitely addresses DOE's goals.

Reviewer 4:
This reviewer indicated that this is a stretch to say that education efforts displace petroleum.

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

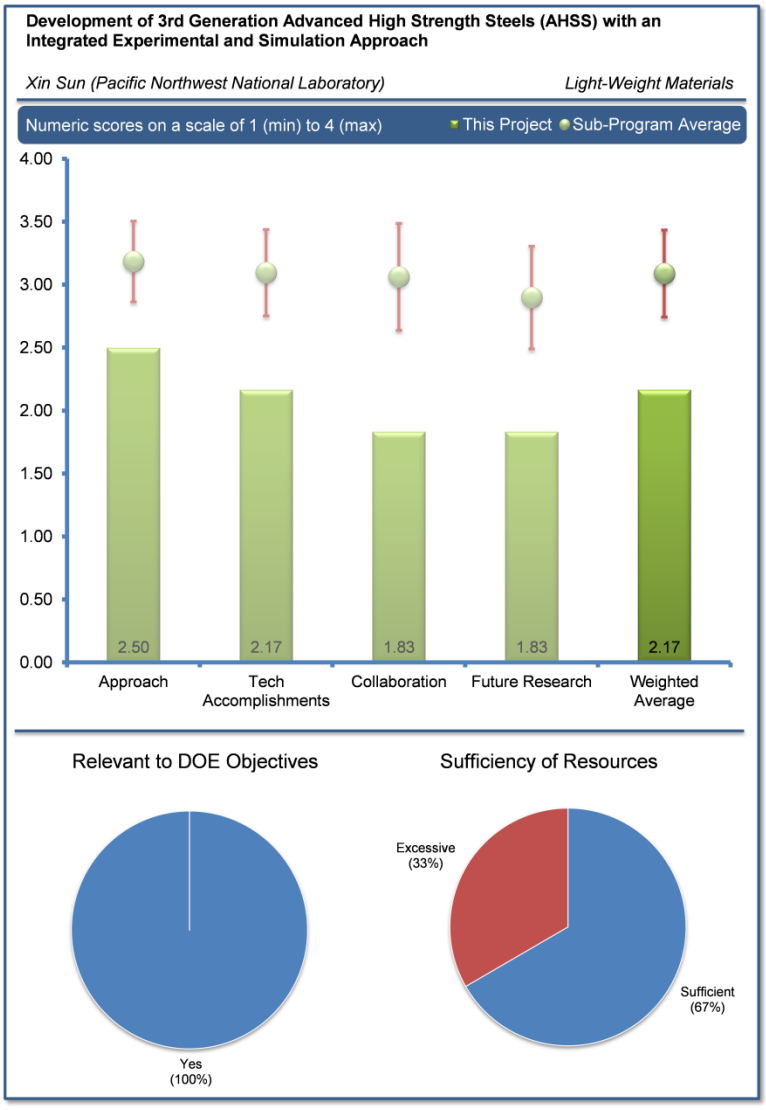
Reviewer 1:
This reviewer is actually very impressed with the amount of research being conducted and the number of students being supported for the amount of funding. The reviewer added that this is a very good investment. Additional funding would presumably increase student participation and grow the program. The reviewer suspected many of the results reported are from mingled funds from various sources (leverage) and not completely attributable to the VTO investment. The reviewer said it was unclear whether an increase in DOE investment would result in increased leverage from other sources. The reviewer added that this possibility should be explored and clarified with UAB.

Reviewer 2:
The reviewer would have liked to see the program to be more encompassing of all aspect of lightweighting.

Reviewer 3:

The reviewer remarked that $120,000 per year is sufficient to fund this effort.

Development of 3rd Generation Advanced High Strength Steels (AHSS) with an Integrated Experimental and Simulation Approach: Xin Sun (Pacific Northwest National Laboratory) - lm082



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 thought-out work plan and executed it well.

Reviewer 2:

The reviewer claimed that the approach was investigative to improve ductility of 1500 mega-Pascal material samples. The reviewer added that the result was unsuccessful.

Reviewer 3:

The reviewer observed that this is worthwhile work and appeared to be conducted in a reasonable manner but to be honest, the reviewer found that the graphics on the slides were simply not informative and did not really add to the quality of the information presented (particularly Slide 4). Also, the reviewer mentioned that the graphics were too small and/or too faint to be easily readable and this also took away from the information being presented. The reviewer said that a much stronger presentation should be prepared for future reviews. From what the reviewer could gather from the presentation and slides, it appears that the project is going okay, but more data on outcomes and how the deliverables outlined at the outset and some words about costs of the new 3G steels would have been welcome. Finally, the reviewer commented that some slides (notably the one feedback from past reviewers) were flashed up and down off the screen so quickly that no discussion or learning was possible from them, while other less useful slides (such as the micrographs and the slides with five or six tiny little plots on the same slide) were discussed at length.

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 is aimed to develop data for the modeling efforts; the selected alloy was fabricated and tested while the models were developed. This process is designed in feedback loop to improve the modeling accuracy. Hopefully this learning will help in the future efforts in developing new steels.

Reviewer 2:

The reviewer stated that it seems that things are happening as expected, but it was not that easy to tell to be honest.

Reviewer 3:
The reviewer claimed that the project team had a poor project approach, lacking technical basis to achieve the project goal. The reviewer added that the characterization of phase fraction and evaluation of tempering is technically quite shallow.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer observed that only a research institution and organization with steel makers are involved; however, their contribution to the project is significant.

Reviewer 2:
The reviewer indicated that relatively little was said about this topic and so the reviewer can only conclude that the collaboration is not that strong.

Reviewer 3:
The reviewer stated that collaboration seemed non-existent. Colorado School of Mines provided samples; PNNL characterized and tempered, and UM was not mentioned.

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 claimed that this is the end of the project; however, the partners are involved in the next AHSS project and the knowledge will be transferred to that project.

Reviewer 2:
The reviewer noted that some information was provided on future work, but it was not that clear and it was difficult to relate it to the stated deliverables of the project. The reviewer added that the supplementary answer provided by the colleague in the audience was much more helpful than either the slides or the main presenter's talk.

Reviewer 3:
This reviewer pointed out that no recommendations were provided to realize the project goal to improve ductility.

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

Reviewer 1:
The reviewer explained that AHSS are needed to reduce the weight of the structures without compromising the safety and increasing the cost; however, many new steels are too expensive due to alloy additions and efforts are being made to produce steels with moderate strength and low cost. The reviewer added that this project is aimed to understand the process-property correlations so that the steels can be used in many applications.

Reviewer 2:
The reviewer stated that there is no question that reducing weight is a key factor in displacing petroleum. Also, the reviewer reported that steels will form a major portion of vehicle structures and components in the future and so work on advanced stronger alloys is very important.

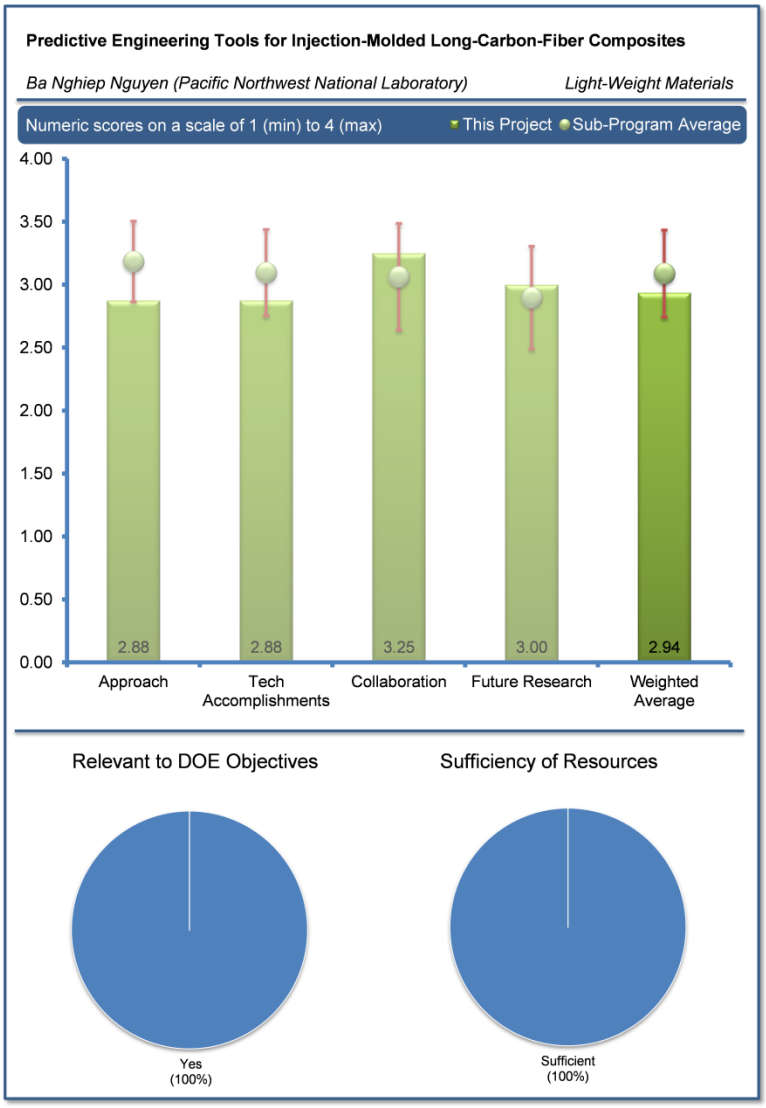
Reviewer 3:
The reviewer remarked that the subject is most relevant to DOE objectives; however, the reviewer warned that the execution is suspect

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

Reviewer 1:
The reviewer indicated that it is hard to say, little was said about the budget or progress as it related to resources during the presentation.

Reviewer 2:
The reviewer opined that the project achieved nothing of value, whatever resource was expended did not contribute to the basis of knowledge.

Predictive Engineering Tools for Injection-Molded Long-Carbon-Fiber Composites: Ba Nghiep Nguyen (Pacific Northwest National Laboratory) - lm083



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 commented that the approach to this work is well grounded in the prior work done with long glass fiber composites. The reviewer added that improving the mold flow's ability to accurately predict CF filled, injection molding grades is needed, as well as standardized material properties for modeling both process simulation and structural analysis.

Reviewer 2:

The reviewer stated that this is a field in which there is significant related work already completed in in the public domain. The reviewer thought more attention has to be paid to material selection. Not all polypropylene (PP) and polyanhydride (PA) resins are equal. The reviewer added that CF is not really designed for those resins and needs to be optimized. The sizing, etc. may not be a good fit and that can have implications on rheology and mold flow as well as mechanical properties.

Reviewer 3:

The reviewer claimed that there needs to be a better tie-in between plaque moldings to three-dimensional (3D) molded parts. The reviewer suggested that CAE evaluations of 3D complex parts need to be done in-phase with the simple geometries to avoid having to fine tune model parameters for planar part that may not be appropriate representation for 3D complex geometry.

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 some significant advances have been made, but there are also some significant holes in the study. The reviewer explained that fiber orientation and fiber length have always been challenging in CF to quantify and this program seems to have made significant strides there. The reviewer added that this is a key part of any model, but the resin properties and the sizing/interface seem to have been ignored or simplified and that is a deficiency in the model.

Reviewer 2:
The reviewer observed that technical accomplishments failed to describe key outputs from fiber orientation and length measurement studies. The reviewer indicated that the material characterization studied did not adequately describe key rheological differences between molded materials at different levels of long carbon weight concentration. Also, the reviewer said it would be rather important to link the process simulation outputs to structural simulations. The reviewer added that very little time was discussed regarding the importance of this linkage.

Reviewer 3:
The reviewer indicated that this project is just getting started. The reviewer noted that the plaques have been molded and the mold flow has been run. This reviewer has a concern over the warped, center gated part shown in the presentation. The reviewer asked if steps were taken during the processing to minimize this warping. This reviewer is also concerned that "small" (7"x7") plaques may not be sufficient to capture steady state flow field in flow and cross-flow directions. Finally, this reviewer suggested keeping an eye on the end result, the physical properties. Fiber length and fiber orientation are the intermediate steps to the physical properties, so a transfer function needs to be developed, and process to develop.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that this team is well balanced across the supply chain, including material supplier, molder, tier, OEM, research institutes and software provider.

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 noted that overall the future research seems to be a good plan, but more attention should be paid to the material choices and formulations.

Reviewer 2:
The reviewer mentioned that the outline for 2014 and 2015 future work is well thought out. This reviewer is looking forward to the results. This reviewer suggests evaluating both continuous (direct long fiber thermoplastic and discrete (long fiber thermoplastic (LFT)) fiber length materials as the industry would benefit from both.

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

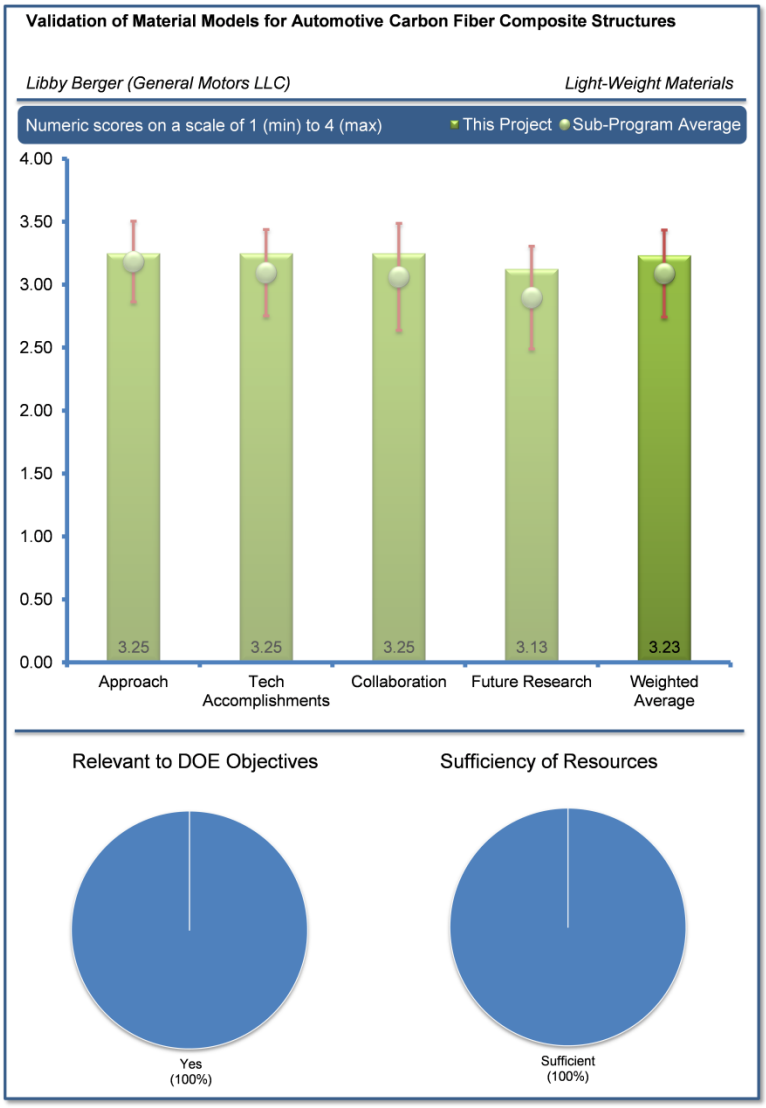
Reviewer 1:
The reviewer indicated that this work is the next logical step following the research work in modeling long glass fiber, injection molded composites and will benefit the future modeling work in continuous fiber composites. The reviewer added that by combining the benefits of continuous fiber composites (impact, strength, stiffness) with the benefits of parts integration that comes with injection molded composites, this work will help OEM engineers develop lightweight automotive applications that can meet current and future fuel economy and greenhouse gas emission regulations.

Reviewer 2:
The reviewer remarked that long fiber glass fiber composites have already had a significant impact on the automotive industry and LFT carbon could have a very significant role to play. The reviewer added that the models and general understanding have to come first.

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

Reviewer 1:
The reviewer noted that the resources seem sufficient along with the commitment of the collaborators.

Validation of Material Models for Automotive Carbon Fiber Composite Structures: Libby Berger (General Motors LLC) - lm084



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 pointed out that establishing the steel benchmark was a good method for controlling geometry effects. The reviewer mentioned that the overall plan is comprehensive and readily understood. The reviewer added that the basic approach is fairly standard. It covers multiple modeling techniques and utilizes state of the art technologies. Leveraging previously developed codes is an excellent way to accelerate the project. The reviewer remarked that while many projects often state they will utilize previously developed code, it is often not practiced for various reasons. The reviewer noted that adding NDE for understanding composite part failure is also a high priority, and it was great that it is incorporated here.

Reviewer 2:

The reviewer stated that the approach was benchmarking against a current commercial steel crush can, and using that information as the baseline for performance is solid. It was unclear whether this was a commercial crush can tuned for a specific vehicle. The reviewer added that it was also unclear as to the target peak loads, and asked whether the rails are capable of carrying more than 140 kilo newton as shown in the force/displacement curve.

Reviewer 3:

The reviewer reported that it is important for the project team to develop a set of comprehensive project risk factors, the rating of the risk factors to success of the project, and an appropriate risk mitigation plan. The reviewer added that the linkage between university based material damage models to implementation of the models with existing commercial software was not described in detail.

Reviewer 4:

The reviewer commented that crash models will be required before CF composites will be fully accepted into the automotive industry. The reviewer would have liked to have seen information on how this expands the knowledge base from what is already known with the BMW i3 and also testing done in auto racing where CF composites are already used.

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 that the crash testing of the steel crush cans is complete and that the material property matrix was completed. The reviewer also stated that the selection of material and process system was completed. This reviewer suggested that the auto industry would benefit from both thermoset and thermoplastic systems.

Reviewer 2:
The reviewer stated that this project seems to be achieving their stated goals on schedule.

Reviewer 3:
The reviewer remarked that the project is significant and well thought out. The milestones are logical and one can see how they build on each other. The reviewer pointed out that understanding the design of composites for energy absorption was excellent. The reviewer added that the learning, correlation of models with simulation, and communication of the results was excellent. The initial work on NDE is good; however, the reviewer would like to know what the NDE goals are. The reviewer also asked what degree of defect resolution with regards to defect type and accuracy/precision is needed and targeted for this project. The reviewer pointed out that aspects of the project two years in are up to six months behind schedule. The reviewer warned that the project should continue to be monitored for future delays.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer indicated that the partners seem appropriate and well established.

Reviewer 2:
The reviewer noted that each subcontractor has a clear task in the project. The interaction is pretty clear based on the logical interactions that are necessary. The reviewer added that the project had clearly defined roles and responsibilities.

Reviewer 3:
The reviewer said that this project has a good representation of OEM's, modeling company, tier and research organizations.

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 the proposed work looks good. The reviewer would like the project team to clarify what “acceptable results” will look like for the composite front bumper crush can. As previously mentioned, this reviewer suggested that the industry would have an interest in both thermoplastic and thermoset composite solutions.

Reviewer 2:
The reviewer indicated that the technical risk appears to be well understood. The reviewer stated that the Project plan is driving the future work. There are not many options for change to address the technical issues. In the future, the reviewer would like to see more detail specifically on the next year of work. The reviewer wanted to know what the technical issues are that will be addressed. The reviewer also asked what the concerns are, where the risks are, and what the mitigation options are, if there are any.

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

Reviewer 1:
The reviewer stated that this work supports the DOE's objective of reducing petroleum usage for vehicles through the development of modeling methods for composites that allow vehicles to be produced that are lightweight.

Reviewer 2:
The reviewer explained that vehicle lightweighting is one of the key technologies for improving vehicle fuel efficiency. Understanding how composite structures behave in a crash and being able to model that behavior is a requirement to ensure commercial adoption of this lightweight material.

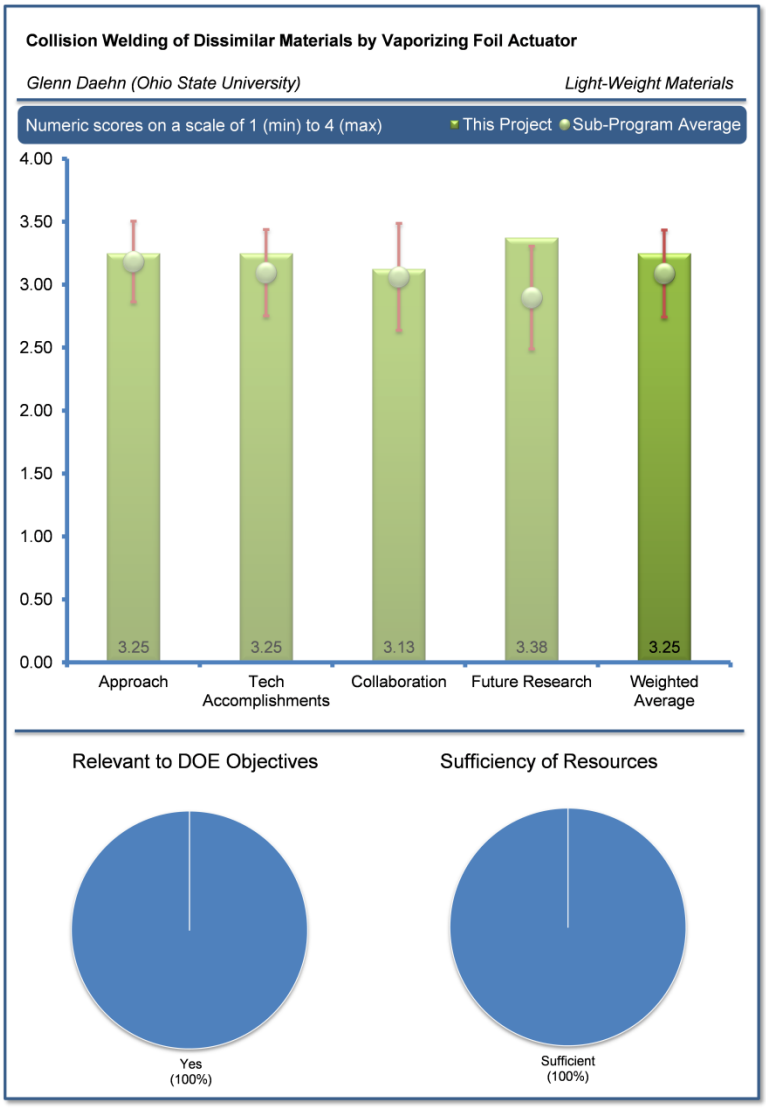
Reviewer 3:
The reviewer pointed out that good baseline data and models are necessary for the industry to have the confidence to push forward.

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

Reviewer 1:
The reviewer claimed that the resources outlined appear sufficient to complete the task.

Reviewer 2:
The reviewer acknowledged that the resources were sufficient; however, the reviewer had one concern. Some milestones are already slipping after the first 12-18 months of a 4 year project. The reviewer then asked how additional slips will affect the project team's ability to keep their academic partners engaged and coordinated with the rest of the team.

Collision Welding of Dissimilar Materials by Vaporizing Foil Actuator: Glenn Daehn (Ohio State University) - lm086



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 thought the grooved approach to evaluate multiple angles in a single experiment was clever and creates very efficient experimental work.

Reviewer 2:

The reviewer concluded that this appears to be a well-constructed proof of concept project.

Reviewer 3:

The reviewer reported the project team had a very good approach. Subject is in early stage; however, investigation was broad base and objective.

Reviewer 4:

The reviewer confirmed that this is an important subject. However, the reviewer explained that the project is not a breakthrough; similar technologies have been developed more than 10 years ago and it is regrettable that no mention was made of them.

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 commented that although, just getting started, the project team seems to be off to a good start. The project team seemed to be doing the right set of experiments early on and presenting the results in a way that are easily understandable. The reviewer added that the angle versus velocity table with micrographs is a great way to understand the bonding regions and parameters.

Reviewer 2:

The reviewer stated that the team has identified a number of critical issues and devised plans to explore and address them.

Reviewer 3:

The reviewer indicated that there was good technical accomplishment and a significant level of understanding has been realized.

Reviewer 4:

The reviewer pointed out that this was a new project, but progress appeared to be on track.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer noted that partnering with an OEM (Honda) and material supplier (Alcoa) provides a connection to both ends of the supply chain.

Reviewer 2:
The reviewer stated that there appears to be active engagement with Honda and Alcoa in selection of materials and processes.

Reviewer 3:
The reviewer remarked that the project does not include a significant amount of collaboration; however, findings are published and disseminated.

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 the research plan addresses the key process parameters and variables needed to develop this process into a robust joining method for dissimilar materials.

Reviewer 2:
The reviewer mentioned that the plan is logical and comprehensive to demonstrate the feasibility of this technique and of potential corrosion mitigation techniques.

Reviewer 3:
The reviewer explained that the project team had a good approach to the future. The reviewer added that the project team was looking for a commercial application to apply high rate joining process.

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

Reviewer 1:
The reviewer remarked that the project is very relevant to DOE goals. The reviewer added that the joining of dissimilar materials will enable significant mass reduction and fuel savings.

Reviewer 2:
The reviewer stated that multi-material joining is a key technical hurdle in greater utilization of lightweight materials in vehicles and this project seeks to develop novel techniques that could be used in select applications.

Reviewer 3:
The reviewer agreed that yes, the project is relevant to DOE, adding that the results can be applied to other applications to enable technology.

Reviewer 4:
The reviewer indicated that the auto industry needs viable and novel techniques for joining of dissimilar materials in various combinations. The reviewer added that it currently appears that this technology may have limitations in the size and shape of parts that can be joined effectively, but it serves as a good proof of concept, that can be developed for more challenging applications if successful.

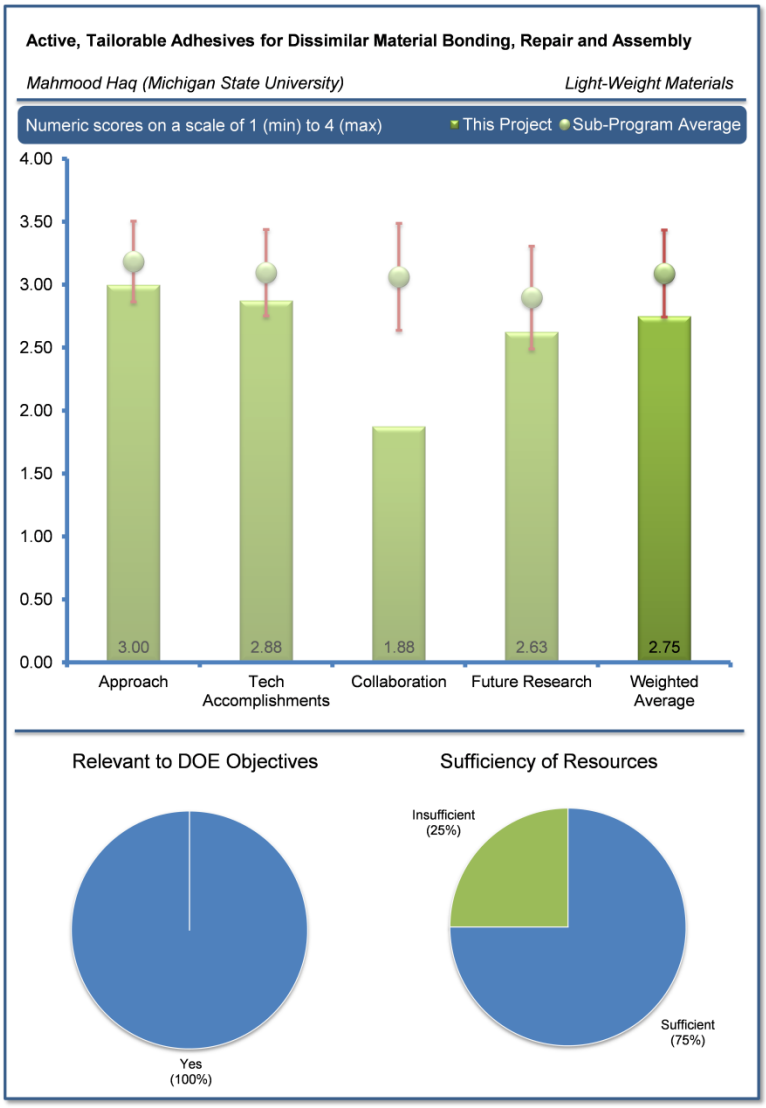
Question 6: Resources: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

Reviewer 1:
The reviewer stated that funding seems appropriate for current challenges and scope of work.

Reviewer 2:
The reviewer noted that the project had sufficient resources to continue early stage evaluation.

Reviewer 3:
The reviewer hoped the resources are sufficient, but they were not convinced that they are.

Active, Tailorable Adhesives for Dissimilar Material Bonding, Repair and Assembly: Mahmood Haq (Michigan State University) - lm087



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 commented that the project team had a good approach, early stage research focus on Nylon-6 versus automotive materials.

Reviewer 2:

The reviewer pointed out that the approach of offering a low-cost additive to conventional adhesives that could address re-use and replacement is a good idea and may prove to be beneficial to greater adoption of this method by OEMs. The reviewer added that the targeted heating option made available through the use of nano-graphene shows promise and is worth the investment in the feasibility evaluation.

Reviewer 3:

The reviewer stated that the approach to proving the concept is generally sound; however, the reviewer saw no mention of baseline comparison to conventional adhesives. The reviewer also did not have a clear vision of what materials this project wanted to focus on. The reviewer added that most of the information seemed to focus on polymer composites, but the test pieces cited were aluminum-steel couples.

Reviewer 4:

The reviewer affirmed that this is a very important subject. The commenter would have liked to have seen a better structured approach. The reviewer described that this is a new project and, is at its beginning, so especially for this reviewer, they asserted that it cannot be everything to everything. The evaluator proposed that the researchers choose one system, solve it, and then apply it to other material systems that are progressively tougher to work with.

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 although just starting in the past six months, reasonable progress in organization and initial evaluation of processing, strength testing and characterization is underway.

Reviewer 2:
The reviewer explained that the early stage of the project revealed reduction in joint strength relative to base material. The reviewer added that the measure needs be relative to alternative adhesives. The reviewer noted that the Al/steel joint was subjected to 250°C and the project team needs to consider impact to over aging Al or inducing stress corrosion cracking. The reviewer stated that the project team needs to revise scope to focus on a few real automotive applications, where the benefit of graphene with a thermoset plastic is of value to facilitate of repair.

Reviewer 3:
The reviewer claimed that the results thus far are limited. The reviewer added that the project shows strong potential, but much more work needs to be done to not only evaluate strength when new, but also after release and re-apply.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer commented that at this stage of development a partner such as Eaton is reasonable to assist with integrating such an additive into commercial products. The reviewer added that partnering with an OEM who would be interested should be a targeted addition in the second half of the projects (Years 3-4).

Reviewer 2:
The reviewer commented that the presentation did not include collaboration partners. The reviewer noted that there was one mention of a turbo charger shaft application with Eaton Corporation.

Reviewer 3:
The reviewer stated that thus far this seems like it is primarily an independent project. It is not obvious that Eaton has contributed to the effort, because this project covers an array of technology gaps (e.g., adhesive bonding, NDE, development of a "reusable" adhesive), it would be good to get some appropriate suppliers involved as well.

Reviewer 4:
The reviewer did not understand why car makers are not directly involved in the 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:
The reviewer stated that the project team has described a reasonable plan for research in the upcoming years.

Reviewer 2:
The reviewer indicated that it appears the project leadership has a good idea of work that needs to be done for the project to be successful (except for the need to include baseline testing and assessment of currently used adhesives).

Reviewer 3:
The reviewer hoped there will be some restructuration of this project.

Reviewer 4:
The reviewer stated that the future work lacks definition and an approach that will be of value. The reviewer recommended that the project team focus on applications that incorporate the benefit of graphene for disassembly/repair. The reviewer also suggested that the project team add an industrial collaborator to provide application and direction.

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

Reviewer 1:
The reviewer remarked that the joining of composites in a way that enables reuse and repair but also eliminates fasteners and stress concentrating holes is addressing a key barrier, joining, to greater implementation in automotive applications.

Reviewer 2:
The reviewer stated that reduction in the use of mechanical fasteners can significantly reduce weight as well as labor needed for assembly. Thus if successful, ability to use adhesive in joints can reduce weight as well as cost, and thereby encourage increased use of dissimilar materials.

Reviewer 3:
The reviewer commented that the joining of dissimilar materials is a means of achieving mass reduction and associated fuel savings. The reviewer added that repair and replacement is the key to commercialization of multilateral structures.

Reviewer 4:
The reviewer agreed that the project addresses DOE goals, and suggested that the method can used in many different fields to enabling technology.

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

Reviewer 1:
The reviewer noted that the project scope needs to be increased to include collaborators, possibly 3M or Henkel and a Tier 1 manufacturer of CF body panels. The reviewer added that the concept is good.

Reviewer 2:
The reviewer stated that if the structure of the project remains as is, the resources are probably sufficient. However, if the participation is increased (i.e., adding car makers), it will be grossly insufficient.

Acronyms and Abbreviations

Acronym	Definition
3-D	Three Dimensional
AHSS	Advanced High Strength Steel
Al	Aluminum
AMR	Annual Merit Review
CAE	Computer-aided engineering
CF	Carbon fiber
CFC	Carbon fiber composite
CFD	Computational Fluid Dynamics
CFTF	Carbon Fiber Technology Facility
CRADA	Cooperative Research and Development Agreement
DIC	Digital Image Correlation
DOD	Department of Defense
DOE	Department of Energy
DP	Dual-phase steel
EPA	Environmental Protection Agency
EV	Electric Vehicle
FE	Finite Element
FLD	Fluid dynamics
FSW	Friction Stir Welding
FY	Fiscal Year
GATE	Graduate Automotive Technology Education
HOV	High-occupancy vehicle
HS	High Strength
HVAC	Heating, ventilation, and air conditioning
ICE	Internal Combustion Engine
ICME	Integrated Computational Material Engineering
IR	Infrared
ksi	Kips per square inch
LCCF	Low-Cost Carbon Fibers
LFT	Long fiber thermoplastic
Mg	Magnesium
MMV	Multi-material vehicle
Nd	Neodymium
NDE	Non-Destructive Evaluation
NDT	Non-Destructive Testing
NF	Nanofiber
NHTSA	National Highway Traffic Safety Administration
NSF	National Science Foundation
NVH	Noise, Vibration, and Hardness
OEM	Original Equipment Manufacturer
ORNL	Oak Ridge National Laboratory

Acronym	Definition
PA	Polyanhydride
PACCAR	Commercial Vehicle Manufacturer (Kenworth, Peterbilt, DAF)
PAN	Polyacrylonitrile
PHS	Press-hardened steel
PI	Principal Investigator
PNNL	Pacific Northwest National Laboratory
PP	Polypropylene
Q&A	Question and Answer
R&D	Research and development
ROI	Return on investment
SAE	Society of Automotive Engineers
Si	Silicone
SIMS	Secondary-ion mass spectrometry
SMC	Sheet Molding Compound
SPR	Surface Plasmon Resonance
TMS	The Minerals, Metals, and Materials Society
TWB	Tailor Welded Blanks
UHP	Ultra high purity
UM	University of Michigan
USCAR	U.S. Council for Automotive Research
UTS	Ultimate tensile strength
VTO	Vehicle Technologies Office
XPS	X-ray Photoelectron Spectroscopy