9. Emission Control and Aftertreatment

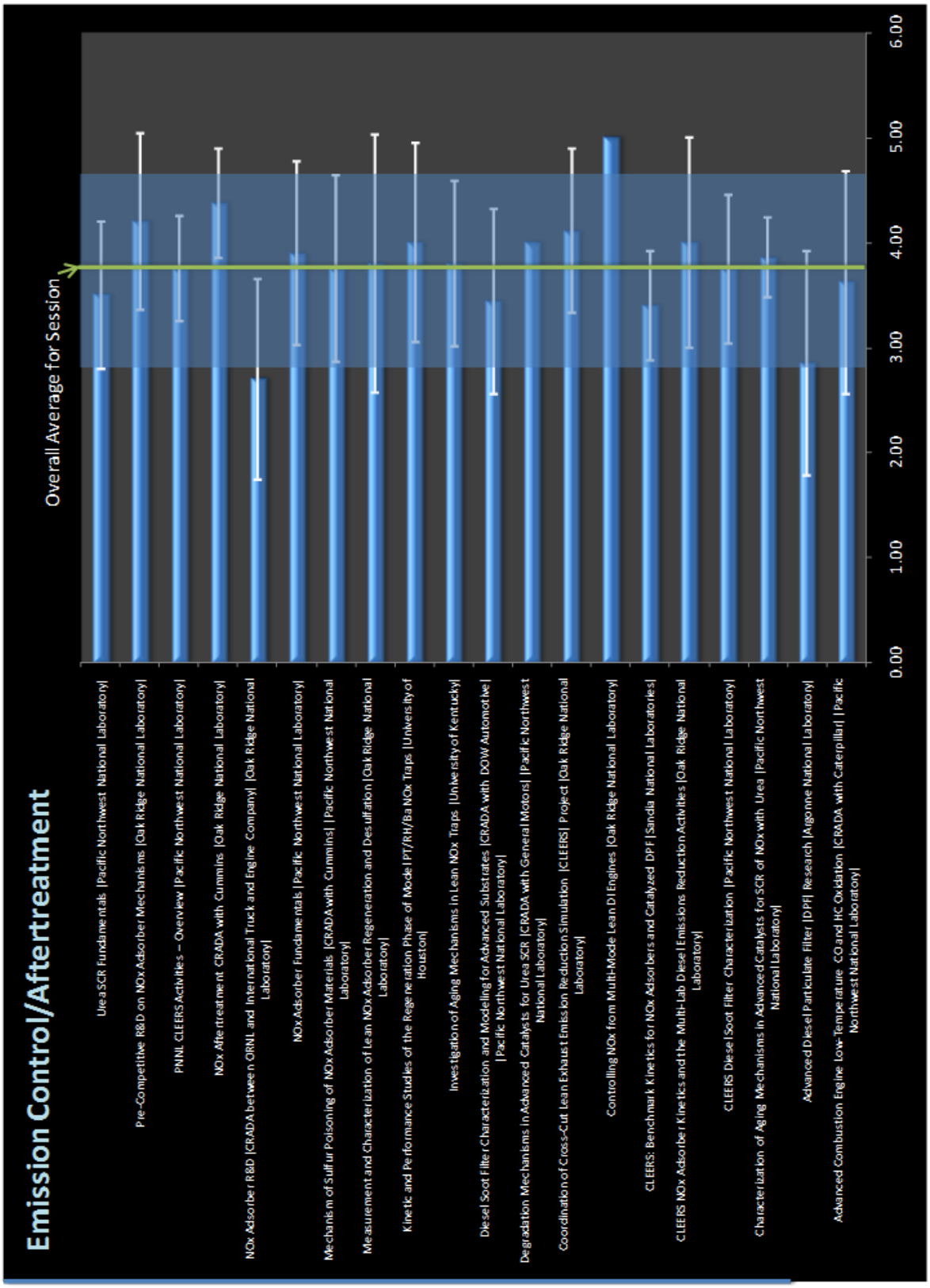
Introduction

Increased use of advanced combustion engines in light-duty vehicles requires compliance with the U.S. Environmental Protection Agency's (EPA's) Tier 2 regulations which are phasing in from 2004-2009. The Tier 2 regulations require all light-duty vehicles to meet the same emissions standards, regardless of the powertrain. Compliance can be achieved with advanced combustion engines through the addition of emission control technologies, though these technologies are much less mature than gasoline engine catalysts and are severely affected by sulfur from the fuel and lubricant. Even the recent reduction of diesel fuel sulfur content to below 15 ppm does not assure that catalytic emission control devices will be durable and cost-effective. This work seeks to improve the effectiveness, efficiency, and durability of engine emission control devices to enable these engines to achieve significant penetration in the light-duty market and maintain their application in heavy-duty vehicles.

In this merit review activity, each reviewer was asked to respond to a series of six questions, involving multiple-choice responses, expository responses where text comments were requested, and one numeric score response. 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 pictorial form in eight graphs as the last page of each project, and the expository text responses will be summarized in paragraph form for each question. A table and graph presenting the average and standard deviation for each project relative to the overall average and standard deviation for this session is presented below.

Page	Project Title and Principal Investigator	Project Average Score	Project Score Standard Deviation
9-4	Advanced Combustion Engine Low-Temperature CO and HC Oxidation (CRADA with Caterpillar) (Jonathan Male, Pacific Northwest National Laboratory)	3.63	1.06
9-7	Advanced Diesel Particulate Filter (DPF) Research (Kyeong Lee, Argonne National Laboratory)	2.86	1.07
9-10	Characterization of Aging Mechanisms in Advanced Catalysts for SCR of NOx with Urea (Charles Peden, Pacific Northwest National Laboratory)	3.86	0.38
9-13	CLEERS Diesel Soot Filter Characterization (Charles Peden, Pacific Northwest National Laboratory)	3.75	0.71
9-16	CLEERS NOx Adsorber Kinetics and the Multi-Lab Diesel Emissions Reduction Activities (Jae-Soon Choi, Oak Ridge National Laboratory)	4.00	1.00
9-21	CLEERS: Benchmark Kinetics for NOx Adsorbers and Catalyzed DPF (Richard Larson, Sandia National Laboratories)	3.40	0.52
9-25	Controlling NOx from Multi-Mode Lean DI Engines (Jim Parks, Oak Ridge National Laboratory)	5.00	0.00
9-28	Coordination of Cross-Cut Lean Exhaust Emission Reduction Simulation (CLEERS) Project (Stuart Daw, Oak Ridge National Laboratory)	4.11	0.78

Page	Project Title and Principal Investigator	Project Average Score	Project Score Standard Deviation
9-32	Degradation Mechanisms in Advanced Catalysts for Urea SCR (CRADA with General Motors) (Charles Peden, Pacific Northwest National Laboratory)	4.00	
9-34	Diesel Soot Filter Characterization and Modeling for Advanced Substrates (CRADA with DOW Automotive) (Darrell Herling, Pacific Northwest National Laboratory)	3.44	0.88
9-37	Investigation of Aging Mechanisms in Lean NOx Traps (Mark Crocker, University of Kentucky)	3.80	0.79
9-41	Kinetic and Performance Studies of the Regeneration Phase of Model PT/RH/Ba NOx Traps (Mike Harold, University of Houston)	4.00	0.94
9-45	Measurement and Characterization of Lean NOx Adsorber Regeneration and Desulfation (Jim Parks, Oak Ridge National Laboratory)	3.80	1.23
9-50	Mechanism of Sulfur Poisoning of NOx Adsorber Materials (CRADA with Cummins) (Charles Peden, Pacific Northwest National Laboratory)	3.75	0.89
9-53	NOx Adsorber Fundamentals (Charles Peden, Pacific Northwest National Laboratory)	3.90	0.88
9-57	NOx Adsorber R&D (CRADA between ORNL and International Truck and Engine Company) (Todd Toops, Oak Ridge National Laboratory)	2.70	0.95
9-61	NOx Aftertreatment CRADA with Cummins (Bill Partridge, Oak Ridge National Laboratory)	4.38	0.52
9-64	PNNL CLEERS Activities – Overview (Darrell Herling, Pacific Northwest National Laboratory)	3.75	0.50
9-67	Pre-Competitive R&D on NOx Adsorber Mechanisms (Jae-Soon Choi, Oak Ridge National Laboratory)	4.20	0.84
9-70	Urea SCR Fundamentals (Jonathan Male, Pacific Northwest National Laboratory)	3.50	0.71
	Overall Session Average and Standard Deviation	**3.73**	**0.92**


Emission Control/Aftertreatment
Overall Average for Session
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Urea SCR Fundamentals |Pacific Northwest National Laboratory|
Pre-Competitive R&D on NOx Adsorber Mechanisms |Oak Ridge National Laboratory|
PNNL CLEERS Activities – Overview |Pacific Northwest National Laboratory|
NOx Aftertreatment CRADA with Cummins |Oak Ridge National Laboratory|
NOx Adsorber R&D |CRADA between ORNL and International Truck and Engine Company| |Oak Ridge National Laboratory|
NOx Adsorber Fundamentals |Pacific Northwest National Laboratory|
Mechanism of Sulfur Poisoning of NOx Adsorber Materials |CRADA with Cummins| |Pacific Northwest National Laboratory|
Measurement and Characterization of Lean NOx Adsorber Regeneration and Desulfation |Oak Ridge National Laboratory|
Kinetic and Performance Studies of the Regeneration Phase of Model Pt/Rh/Ba NOx Traps |University of Houston|
Investigation of Aging Mechanisms in Lean NOx Traps |University of Kentucky|
Diesel Soot Filter Characterization and Modeling for Advanced Substrates |CRADA with DOW Automotive| |Pacific Northwest National Laboratory|
Degradation Mechanisms in Advanced Catalysts for Urea SCR |CRADA with General Motors| |Pacific Northwest National Laboratory|
Coordination of Cross-Cut Lean Exhaust Emission Reduction Simulation |CLEERS| Project |Oak Ridge National Laboratory|
Controlling NOx from Multi-Mode Lean DI Engines |Oak Ridge National Laboratory|
CLEERS: Benchmark Kinetics for NOx Adsorbers and Catalyzed DPF |Sandia National Laboratories|
CLEERS NOx Adsorber Kinetics and the Multi-Lab Diesel Emissions Reduction Activities |Oak Ridge National Laboratory|
CLEERS Diesel Soot Filter Characterization |Pacific Northwest National Laboratory|
Characterization of Aging Mechanisms in Advanced Catalysts for SCR of NOx with Urea |Pacific Northwest National Laboratory|
Advanced Diesel Particulate Filter (DPF) Research |Argonne National Laboratory|
Advanced Combustion Engine Low-Temperature CO and HC Oxidation |CRADA with Caterpillar| |Pacific Northwest National Laboratory|

Advanced Combustion Engine Low-Temperature CO and HC Oxidation (CRADA with Caterpillar) (Jonathan Male, of Pacific Northwest National Laboratory)

Reviewer Sample Size
This project had a total of 9 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that HCCI offers potential to significantly reduce engine-out NOx - furthermore this topic is essentially developing a scheme to design a new oxidation catalyst chemistry - very cool if it works. Another reviewer cited this was an excellent CRADA dealing with low temperature combustion. One reviewer commented that low temperature DOC function is critical for HCCI, and also for idle and low load diesel engines.

One reviewer commented that improved low temperature performance of oxidation catalysts will reduce petroleum use by reducing the need for low efficiency operation of diesel engines during active regeneration. Another reviewer believes that HCCI technology should be central in the VT menu. It was stated by a reviewer that low temperature CO and HC oxidation catalysts enable HCCI to reduce gaseous emissions. HCCI is a high fuel efficiency operation mode. A reviewer felt that the program was in line with the DOE formulation.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer commented on an encouraging approach and robust plan. Another stated that the answers above are yes/no: here, the reviewer felt a need for a confidence level. The reviewer adds that this is a very difficult task, and that the project has made useful progress, but it remains uncertain whether the 50% HC conversion at 150°C can be achieved. The reviewer continues that even if not, it seems useful progress has been made.

One reviewer stated that mostly experimental tools have been applied to evaluation of novel substrates and catalysts. Another reviewer stated that adding praseodymium into the CeO_2 system appeared to have a promising effect by increasing oxygen storage capacity, which promotes low temperature oxidation activity. The praseodymium addition also maintains pore volume and pore size and optimal dispersion of Pd catalyst.

A reviewer stated that it was a good discovery project, but wondered if the cost of praseodymium was cheaper than the catalysts with the higher PM content. Another reviewer was unsure that the technical barriers will be overcome. One reviewer believed that a fundamental understanding will lead to invention of new catalyst support material composition to enhance catalyst performance at low temperature.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
A reviewer comments that there has been good progress on a difficult task. Another reviewer said that there were interesting and useful findings with respect to influence of substrate chemistry and catalyst selection on oxidation efficiency. Another reviewer felt the findings would be useful to a catalyst designer.

One reviewer commented that competition with catalyst suppliers is useful, and that the partnership with Caterpillar should be helpful. Another stated that the CRADA is using an array of tools to redesign a catalyst from scratch to allow HCCI to be applied. The reviewer continues that the application of this approach can be applied to any engine system - this CRADA shows the advantages to collaborative development. A reviewer believed that activity after aging was lacking and that quick results on aging are crucial.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer stated that the project will transfer the knowledge to catalyst suppliers. One reviewer felt that competition with catalyst suppliers is useful. Partnership with Caterpillar should be helpful. Another reviewer cited activity with Caterpillar and presumably its suppliers. One reviewer commented that since the project is a CRADA with an industrial partner (Caterpillar), it is very likely for any useful results to be commercialized. A different reviewer wondered if the suppliers already know most of this, believing that if not, this material should be very useful. It was said, by a reviewer, that the catalyst showed promising performance, although aging and durability needs to be carried out next year.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

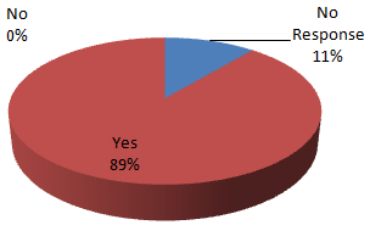
A reviewer suggested the project should not run its "own engine testing" at PNNL, but rather should leave that to Caterpillar. Another reviewer felt that collaborative research with Caterpillar should be enough on aging testing and durability testing. Another reviewer felt that funding of $250,000 seems adequate considering that there is an equal amount spent by the industry partner under CRADA.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

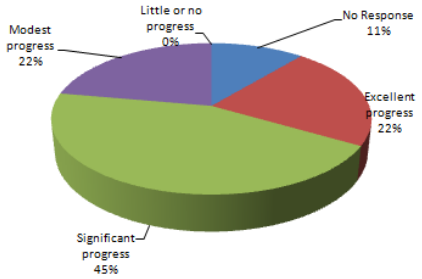
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Advanced Combustion Engine Low-Temperature CO and HC Oxidation (CRADA with Caterpillar)

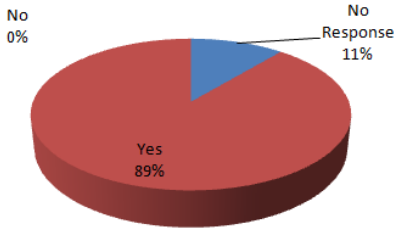
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



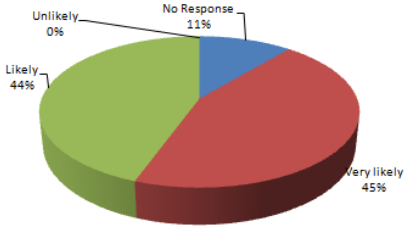
Question 3: Characterize the technical accomplishments and progress toward goals.



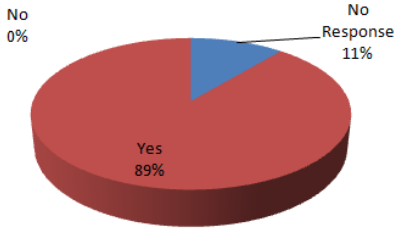
Question 2a: Are the goals of the project technically achievable?



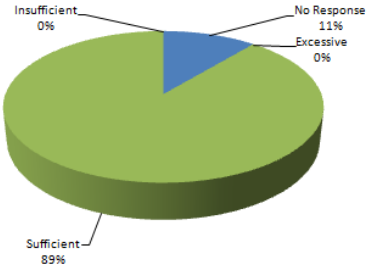
Question 4: How likely is the project team to move technologies into the marketplace?



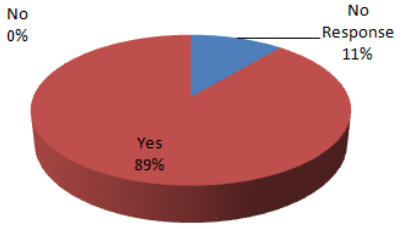
Question 2b: Have the technical barriers been identified and addressed?



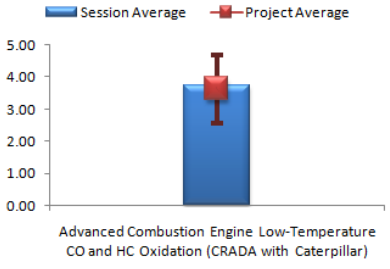
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Advanced Diesel Particulate Filter (DPF) Research (Kyeong Lee, of Argonne National Laboratory)

Reviewer Sample Size
This project had a total of 8 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that theoretically DPF advanced developments have a minor impact on BSFC, but the tools and methods to design aftertreatment without the normal "cut and try" approach allows for intelligent integration and a real potential to advance the state of the art that could deliver significant BSFC and cost advantages that may open the door for light-duty diesel. Another reviewer said that DPFs are essential for dieselization, and they cost fuel efficiency. One reviewer cited improved understanding of DPF filtration and regeneration as having a high potential of reduced diesel fuel use (both due to higher efficiency associated with lower pressure drop and fuel use during regeneration if it occurs at lower temperatures or less frequently). A reviewer felt that the DPF is a major stumbling block to future diesel usage. The reviewer adds more work is welcome; there is a need to better understand the particles, to prevent them. One reviewer felt that optimization of DPF systems and their application would contribute to their improved fuel efficiency. Another reviewer stated that it was a unique study of soot structure and the oxidation properties of each type of structure are interesting. Another reviewer adds that VT emissions can't be dealt with until emissions control is addressed. The reviewer adds that emissions control has an associated energy penalty.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer comments that the technology is mandated, industry struggles with the best implementation methods, and deployment should be readily achieved. Another reviewer states that this project applies our latest understanding of soot morphology to the design of DPF, but the advantage of this additional detail is not well described, and it is easy to say - So what? The reviewer asks what is lacking from the simplifications that previous projects have made. The reviewer continues that fuel additives should not really be a major focus – this is OK to look at, but not clear why this is presented.

A reviewer states that it is important to explain more details of the washcoat used. Another reviewer comments that other institutes have done similar work, as stated in slide 4. The reviewer goes on to ask why this cannot be done elsewhere and what national lab core competency it requires.

A reviewer states that the objectives seem loose and perhaps overambitious. The reviewer suggests concentrating on how soot collects in and burns off the pores; regeneration strategies and runaway control seem beyond the scope of this lab setup. The reviewer continues that it may be appropriate to wait for firm objectives until we see what the system can do. This system may be useful to gather data for verification of various DPF models.

Another reviewer comments that the experimental setup seems to be state-of-the-art, especially translation imaging system. One reviewer sees images as the key to better design direction. The reviewer adds that it is still in the early phase but there is an expectation that the results will be very useful and powerful. The results will help validate models.

Another reviewer suggests that the controlled microreactor will provide valuable insights into the mechanisms of soot collection and regeneration.

One reviewer felt that the objectives and overall strategy for this project were not clearly defined in the presentation. The reviewer adds that there is no doubt that very substantial technical challenges exist with the DPF technology and that better understanding of these would be lead to more robust and fuel-efficient DPF systems, but it is not clear which specific aspects of the DPF technology this program is planning to address and how the information from this program is intended to be applied.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer commented that there were lots of descriptions of equipment and sensors, but video results could not be shown. The reviewer felt that the purpose behind the work was not communicated. The reviewer wondered why this work is important. The reviewer felt the research did not communicate this. Another reviewer stated that it is merely an exercise that does not really address technical barriers. One reviewer said that although not stated, it seems like this project is very early and there are not real research results yet. One assumes more results will come when the system is set up and in use. Another reviewer commented that the project just started last year, and while there are no significant results yet, the engine dynamometer setup and reactor bench/imaging system have been completed. A reviewer commented on the micro imaging system as a wonderful contribution which should aid in understanding this complex system. Another felt that it was good to see the use of visual technology. Another reviewer said that impressive experimental capabilities were established during the first year of the project, consistent with the fairly high level of funding.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

Reviewers commented on the participation of industry, and that the industrial partners would be able to make direct use of learning when it comes. Another reviewer commented that the use of visual technology is a very effective means of technology transfer. One reviewer wonders how Corning was going to develop a higher thermally stable material. The reviewer questioned which data from this project helps them to design an improved substrate, and adds that the high resolution images shows that the Corning material is not very uniform. Another reviewer felt that this was work for others.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

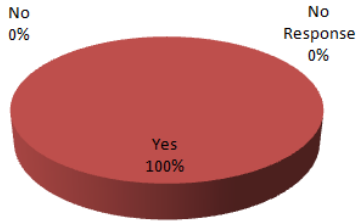
A reviewer felt that funding of $400,000 seems sufficient, considering the similar spending from the CRADA partners. Another reviewer wonder why fund it at all?

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

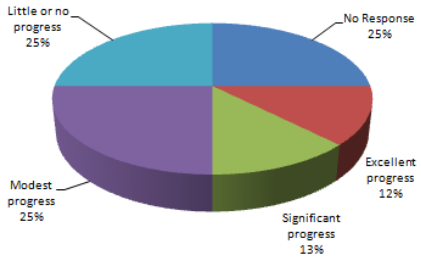
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Advanced Diesel Particulate Filter (DPF) Research

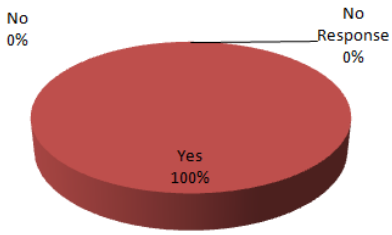
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



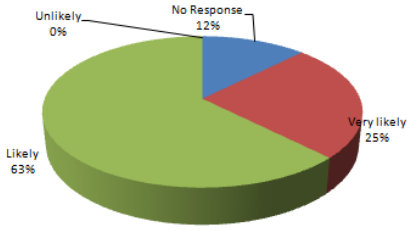
Question 3: Characterize the technical accomplishments and progress toward goals.



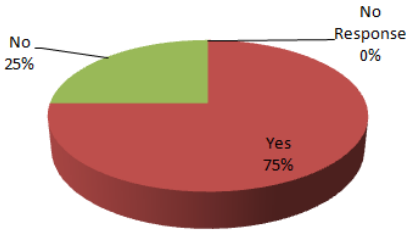
Question 2a: Are the goals of the project technically achievable?



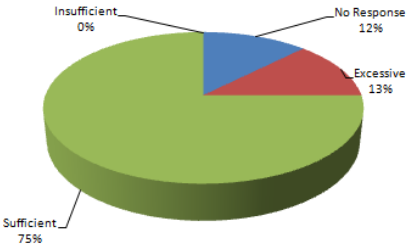
Question 4: How likely is the project team to move technologies into the marketplace?



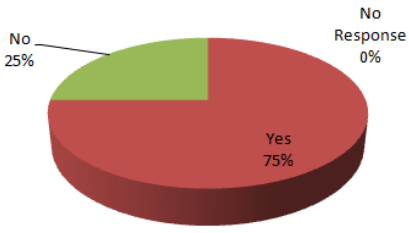
Question 2b: Have the technical barriers been identified and addressed?



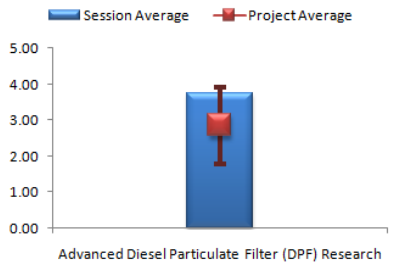
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Characterization of Aging Mechanisms in Advanced Catalysts for SCR of NOx with Urea (Charles Peden, of Pacific Northwest National Laboratory)

Reviewer Sample Size
This project had a total of 8 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that active NOx catalysts have tremendous potential to improve BSFC. A reviewer mentioned that better understanding of selective catalytic reduction aging is critical in improving the performance of urea selective catalytic reduction, which is the only NOx reduction approach with the potential of actually reducing use of diesel fuel, while meeting future emission regulations. It was also said by another reviewer that selective catalytic reduction technology is a leading solution for the lean deNOx, while another felt that implementation of the SCR aftertreatment system is expected to lead to improved fuel efficiency.

Another reviewer commented on the CRADA with Ford having kicked off in February 2007. The reviewer felt it definitely was a viable technology in the medium and heavy duty diesel markets, assuming the urea infrastructure is viable and the cost of the second fluid is minimal. One other reviewer mentioned it being a Ford CRADA. A reviewer felt the project was certainly consistent with the desire for DOE to emphasize short term commercialization.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer mentioned realistic aging protocols for time/cost savings. The reviewer added that barriers are well-recognized in terms of durability in the absence of field history. The reviewer continued that urea-induced deactivation of zeolite (alumina or copper based) and that it was not apparent how this will be overcome. One reviewer said that laboratory aging protocols are very important. Another reviewer stated that the goal of the program is to learn the fundamentals of catalyst aging and durability, so that the engine and vehicle testing protocol can be formulated.

A reviewer commented that the technical approach makes the optimum use of the strengths of CRADA partners - Ford and PNNL. Another reviewer stated that the project was aiming at a Ford development need.

One reviewer felt that this was exactly the type of program which can help industry and also help the OEM's synergize. The reviewer add that this is an excellent model program for how our national labs through CRADA can work and supply useful research to the private sector.

Another reviewer stated that the project objectives/scope are very clearly defined and are based on a well-documented case of catalyst failure (SAE papers and DEER presentation); the tools employed by PNNL are uniquely useful for the task and not available to the industry (e.g. NMR)

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
A reviewer stated that aging, in the presence of urea, revealed previously unknown effects such as large deposits upstream and/or on monolith catalysts (urea decomposition) polymerization of cyanuric acid, and wondered how this can be overcome.

A reviewer stated that the project had found unexpected aging results, and was still learning. Another commented that after only one year of work, some important technical accomplishments have already been achieved.

One reviewer commented that new deposits are identified during the aging as unreactive urea and crystalline cyanuric acid and urea-cyanate. The reviewer adds that aging of catalyst supported on monolith showed the catalyst at entrance was deactivated, from chemical species from fuel and lubrication. The reviewer felt that urea induced de-alumination is another part of deactivation mechanism, and added that a new copper species was identified.

Another reviewer commented that Al27 NMR measurements, along with other material characterization techniques, provided clear evidence of the zeolite material changes underpinning the observed performance changes.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer found that there had been good collaboration and sharing of tasks based on capabilities. Another mentioned that there was already an industrial partner involved.

One reviewer felt that since the CRADA seems to have been formed in response to specific issues identified by the industry partner (Ford), it is very likely that any useful technical results will be used and implemented. The close involvement with an industrial partner was commented on by other reviewers as well.

A reviewer noted that the results will help the complete system design, and added that fundamental understanding on SCR catalyst aging will help to solve the aging issues.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

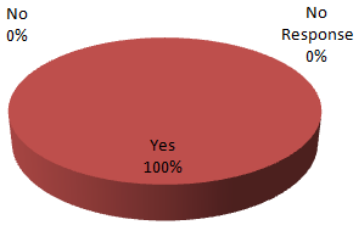
A reviewer stated that $100,000 was used for the first year, and wondered if this increased over the life of the CRADA. A reviewer commented that the funding can only cover 0.4 FTE of a junior scientist. The reviewer adds that this seems inadequate to the magnitude of the technical challenge and to the potential influence of the project success on the reduction of diesel fuel use in advanced engines. Another reviewer felt that the current level of funding limits this CRADA to a quite narrow focus on diagnosing a specific failed selective catalytic reduction system. One reviewer felt that the cost per technical person at PNNL (and all national labs) is excessive. This comment applies to ALL projects. The reviewer adds that the work can't and shouldn't be exported to China and India, but must be competitive globally!

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

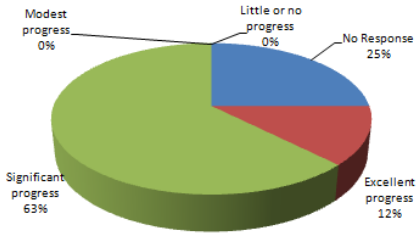
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Characterization of Aging Mechanisms in Advanced Catalysts for SCR of NOx with Urea

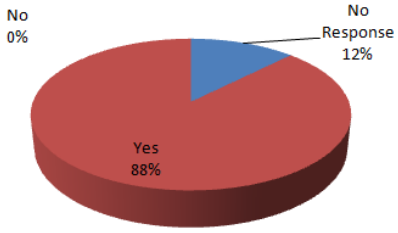
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



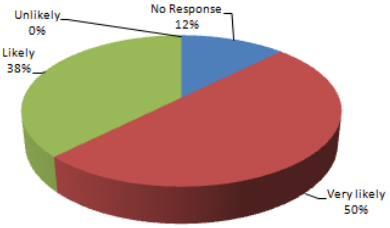
Question 3: Characterize the technical accomplishments and progress toward goals.



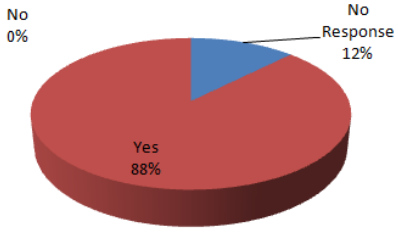
Question 2a: Are the goals of the project technically achievable?



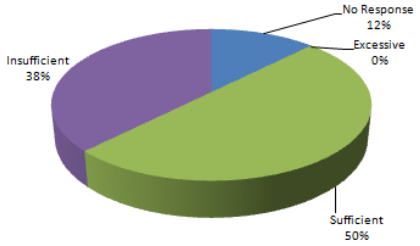
Question 4: How likely is the project team to move technologies into the marketplace?



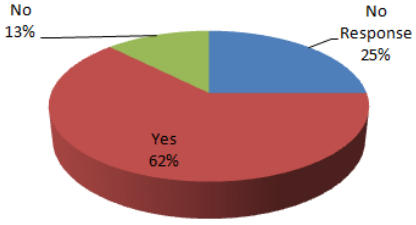
Question 2b: Have the technical barriers been identified and addressed?



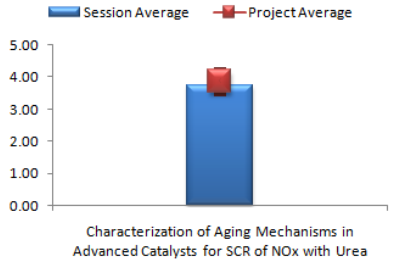
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



CLEERS Diesel Soot Filter Characterization (Charles Peden, of Pacific Northwest National Laboratory)

Reviewer Sample Size
This project had a total of 8 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that the project is promoting net fuel efficiency through experimental data combined with micro modeling. Another reviewer said that diesels need NOx catalysts. One reviewer mentioned deeper understanding of DPF mechanisms is very likely to result in devices with lower pressure drop, better filtration efficiency, less frequent active regeneration events, all leading to reduced use of petroleum. The reviewer went on that better understanding of urea-SCR mechanisms is very likely to result in devices with lower pressure drop, lower urea consumption, better catalytic efficiency, all leading to reduced petroleum use. A reviewer felt that this was directly related to the DOE focus. One reviewer commented that aftertreatment is very important to diesels becoming a commercial reality. Another reviewer mentioned optimization of DPF systems and their application would contribute to their improved fuel efficiency. It was stated by a reviewer that fundamental understanding on DPF systems with collection efficiency, regeneration and back pressure is highly industry relevant.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer commented that the project was comparing cordierite with other substrates e.g., SiC. The reviewer added that particulate size effects had been examined. The reviewer continued that there was a good test strategy to build/verify understanding from aerosol surrogates (salts) to controlled combustion aerosol (MiniCAST) to diesel engine test. The reviewer also noted the conducting of regeneration studies.

A reviewer stated that guidance from industry members of the CLEERS consortium creates a high probability of the deployment of technologies and utilization of fundamental understanding developed in this project. Another reviewer expected that understanding on the molecular level should translate to successful modeling.

One reviewer felt that the report was not risky. Another reviewer commented on the unique experimental approach employing a single-channel system which provides an opportunity for controlled loading of particulate matter and subsequent non-disruptive evaluation due to particulate matter layer being exposed.

The project was also commented on, by a reviewer, as having used synthetic nanoparticles with monodispersion and a single wall filtration apparatus to simulate the soot collection process on DPF. The reviewer added that the cake formation process was monitored through the filtration efficiency and backpressure.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
A reviewer stated that this was good fundamental work, but that the need to correlate to results with filter physical parameters is poorly defined. The reviewer adds that DPF characteristics have more impact on the performance and insights to it are highly valuable for better designed DPF system. One reviewer felt that more needs to be done on soot regeneration events, as well as measurement of

particle sizes during regeneration events. Another reviewer stated that things were good so far, but that there were still many questions to be answered. A reviewer commented on transition from depth filtration to cake filtration as a function of loading for different materials; correlation/validation with salt particle penetration (ammonium sulfate). One reviewer believed the project closely parallels commercial supplier work.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer believes that any improvement in DPF and SCR performance derived from this research is very likely to enter the marketplace immediately due to its direct impact on efficiency and emissions. Another reviewer stated that this was solid and fundamental.

Another reviewer commented that the use of ammonia sulfate may not be representative to be filtration behavior in the filter due to surface interactions with DPF materials, although provided nice particle size range. The user added that more detailed work is needed to clear this argument.

Two reviewers commented on the close work with industry, and another mentioned good networking with the CLEERS system. One reviewer talked of efficient information dissemination being ensured by the CLEERS structure.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer felt that the project focus needs to address the fundamental of DPF microstructure, pore size and its distribution on filtration efficiency, backpressure, if DPF manufacturers allow the disclosure of this information.

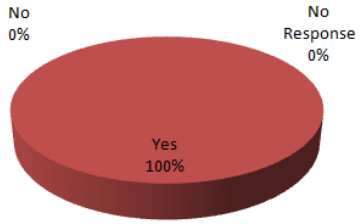
Another reviewer stated that it was their understanding that this project (10048), in spite of its title, actually covers two areas of research - DPF and urea SCR. The reviewer added that as such, resources seem inadequate, especially since this seems to be the only project under CLEERS dedicated to technologies other than a NOx adsorber. The reviewer would recommend moving more of the CLEERS resources from NOx adsorber projects to DPF and SCR projects. The reviewer lists specific areas of research that could be covered with more funding as ash deposition and migration in the DPF, oxidation of biodiesel derived soot, compared to soot from petroleum diesel fuel, and ways to reduce urea consumption of SCR.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

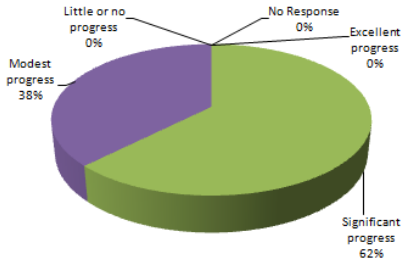
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: CLEERS Diesel Soot Filter Characterization

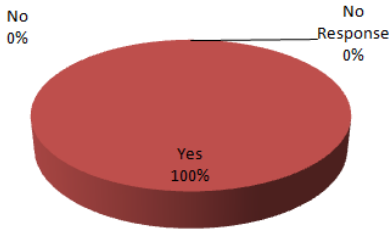
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



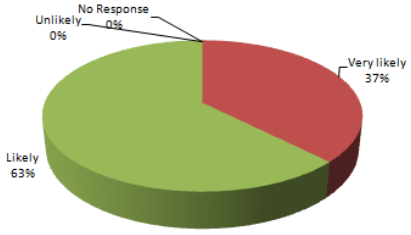
Question 3: Characterize the technical accomplishments and progress toward goals.



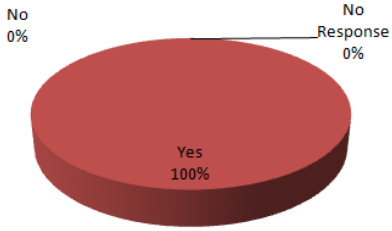
Question 2a: Are the goals of the project technically achievable?



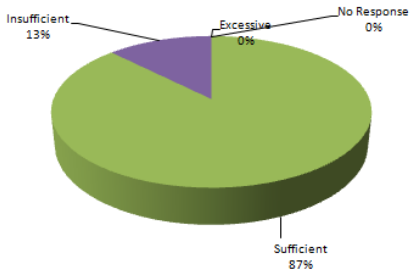
Question 4: How likely is the project team to move technologies into the marketplace?



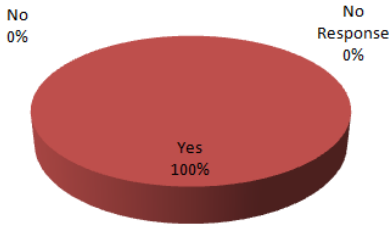
Question 2b: Have the technical barriers been identified and addressed?



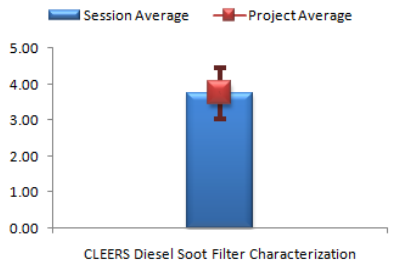
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



CLEERS NOx Adsorber Kinetics and the Multi-Lab Diesel Emissions Reduction Activities (Jae-Soon Choi, of Oak Ridge National Laboratory)

Reviewer Sample Size
This project had a total of 10 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that any reduction in NOx emissions via active aftertreatment provides potential to break the traditional BSFC - NOx tradeoff. The reviewer adds the consortia-based, non-competitive based approach moves the industry/academia forward in a collaborative way - the end result is better thermal efficiency. Another reviewer felt that the program was valuable for coordination, adding that various companies cannot communicate easily and that CLEERS creates a forum where communication can occur. A second reviewer also felt that it is important to keep interacting with all cross sections of the emission industry.

One reviewer stated agreement that the sulfation and deSOx is the most important issue facing LNT implementation. The reviewer adds that lowering the DeSOx temperature is the key barrier. Another reviewer stated that understanding of NOx adsorber kinetics and sulfur poisoning process can help the development of lean-burn gasoline engines, which can reduce petroleum use. A reviewer says that the LNT chemistry and kinetics for NOx control are highly desirable. The reviewer adds that analytical/numerical tools and models are useful for fundamental understanding and data collections. The reviewer continues that the tools and models will help identify the system level energy inefficiency, provides potential solution to resolve emission control bottlenecks. The reviewer concludes that sulfation and desulfation are critical to LNT performance in real world.

A reviewer stated that the early NOx adsorber systems on the market are quite non-optimal and better understanding of this technology should lead to improved fuel efficiency. Another reviewer said that dieselization critically depends on NOx catalysts. The reviewer adds that current LNT technology is loosely understood, and both very expensive and not very robust.

One reviewer stated that the program was enabling technology for advanced diesels, and should result in improving the utilization of high efficiency diesels. The reviewer found the program completely in sync with the DOE mission. Another reviewer expressed concerns that the objectives of the research were not made very clear.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer believes that with this being a consortium-based program, deployment is essentially automatic. The reviewer adds that the steering committee has a heavy industry focus including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer continues that DOE may want to consider having a similar consortia operating for other research and development programs to enable or accelerate deployment

Another reviewer states that the project is building on the extensive technical capabilities established at FEERC, including equipment and experience of NOx adsorber catalysts operation, and in particular the capabilities of SpaciMS to evaluate spatially-resolved gas composition. One reviewer says that the nature of LNT sulfation and catalyst composition impact on sulfation have been addressed in this work, the reviewer adds that it also addressed the sulfation impact on NOx storage, oxygen storage

and reductant consumption for regeneration of the catalyst, with all the data available, the operation model is conceptualized.

One reviewer saw the program as a basic research project, and suggested bridging it to some possible application concepts at NTRC-ORNL. Another reviewer expressed doubts that it was likely sulfur poisoning issue to be resolved, even with deeper understanding of the physics behind the process.

One reviewer commented that the Umicore sample should not be the only LNT system investigated. The reviewer added that other materials should be characterized with a goal to lower the DeSOx temperature. High temperature DeSOx should not come at the price of poor low temperature NOx performance.

It was commented by a reviewer that the reference catalyst is very useful and interesting, but no one will make the most up-to-date catalysts available for such detailed study in a public forum. The reviewer suggested that, when possible, to look at another fully formulated catalyst. Another reviewer said that the technical barriers are identified at this point. A different reviewer commented that the key is to how this kinetic investigation translates to commercial proprietary systems which may or may not be similar to the model system.

One reviewer expressed his opinion that the project is mainly reporting results; this reviewer didn't understand barriers or difficulty references.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer stated that CLEERS is more focused on methodologies and deployment or these, rather than on specifically overcoming the identified technical barriers. The reviewer adds deployment aspects of coordinating National Lab and academia towards industry needs will continue to pay increasingly significant dividends over time. The reviewer thinks this approach deserves a spot in DOE strategy.

Another reviewer felt that there had been good progress on identifying mechanisms of sulfation. The reviewer felt that there needed to be clear alignments with variations in compositions due to processing of wash coat; i.e., was there adequate statistical sampling across the original full-size sample?

A reviewer commented that although this was a purely catalyst and materials research program, the researchers have taken some effort to relate their work and findings to real life issues/challenges. The reviewer continued that the researchers should expend more attention in this area. The reviewer saw the mention of tool development as a plus.

A reviewer felt that relevant and state-of-the art characterization techniques have been applied to the study of NOx adsorber kinetics and sulfur poisoning. The reviewer added that no routes to elimination of the sulfur poisoning have been identified so far. Another reviewer commented that the program certainly has the analytical and microreactor resources to accomplish their tasks.

One reviewer commented that sulfur sensitivity to Ba is not a surprise. 700°C TPR is not high enough. The reviewer added that some of the sulfur may need higher temperature. Another reviewer commented on good clarification of sulfur storage sites. A reviewer commented that NSR and OSC affected by sulfur were determined to have two different mechanisms, verified by NOx reduction and ammonia forming.

It was commented by a reviewer that there was an outstanding job bringing together a number of significant aspects of the catalyst operation into a single physical model, such as NOx performance, OSC, WGS, and sulfur impact. The reviewer adds that this appears to be an excellent example of long-term work on a complex, multi-faceted subject coming together into a single coherent picture. The reviewer continues that the results were clearly underpinned by a very large volume of high quality experimental work/data.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer states that with this being a consortium-based program, deployment is essentially automatic on all levels (from what we learn of the hardware, to the diagnostic methods, to the cross-fertilization of the different technical discussions, to other insights into the underlying physics). The reviewer adds that the steering committee has a heavy industry focus - including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer suggests that DOE may want to consider having similar consortia operating for other R&D programs to enable or accelerate deployment. The reviewer felt that CLEERS is not really developing specific aftertreatment technologies that would apply to an engine; rather it is using standard commercially available catalysts to develop better understanding and methodologies, in DOE's diverse portfolio, and that this is an excellent program. The reviewer suggests that more opportunities for this approach should be applied to other programs if possible to further enhance deployment.

Another reviewer suggests that DeSOxing the LNT at the lowest temperature possible to avoid thermal deactivation should be the key emphasis. The reviewer suggests that other materials besides the Umicore sample should be investigated. Another reviewer comments that fundamental understanding on sulfation of LNT catalyst system is critical information for catalyst formulation and design.

A reviewer notes that industrial partners seem closely involved. Another reviewer says that it is imperative that the LNT producers are plugged into this work, if not the researchers will be studying things not relevant or, worse yet, been done by the Johnson Matthey's/Engelhard's etc. A reviewer felt the program could be enhanced if a specific industrial entity "owned" the project rather than the pool involved in CLEERS. Another reviewer commented that the team cooperates closely with industry via CLEERS and several CRADAs.

A reviewer doubts that sulfation of NOx adsorbers would be resolved. Another reviewer concluded that the translation to industry will be burdened by real world application issues associated with flow distribution and species concentration distribution. That reviewer also commented that the flow appeared to be steady state, creating plug-like poisoning--not the real world situation.

One reviewer felt that since the study is precompetitive, there is a likelihood of a follow up program to apply and transfer the technology.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

One reviewer wondered why DOE was sponsoring this project at Oak Ridge National Laboratory, and if the project was completely awarded. The reviewer also wonder if there was a rationale for review of the CLEERS charter and funding level since the focus now is on more deployment rather than basic research?

Another reviewer commented that the project had a talented staff and the equipment to study this system. One reviewer saw the project as so vital to diesel eventual success eventually, and didn't think the resources are adequate. Another reviewer felt the funding was adequate, but wondered about overlap with other national labs.

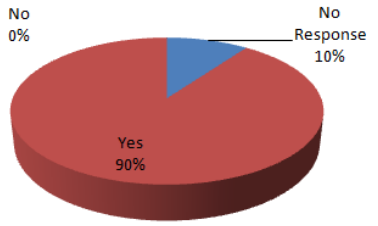
A reviewer believes the CLEERS return on investment is very good due to the collaborative approach and the focus on methodologies and base understanding over developing new hardware.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

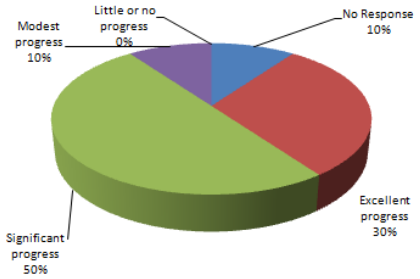
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: CLEERS NOx Adsorber Kinetics and the Multi-Lab Diesel Emissions Reduction Activities

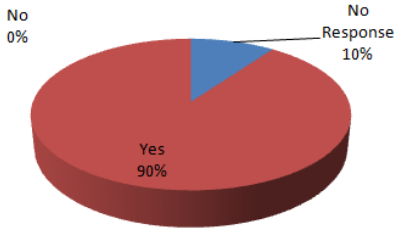
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



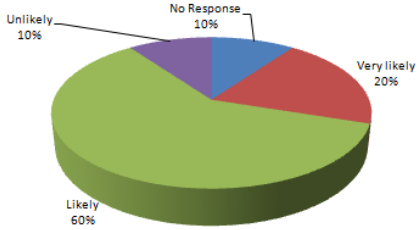
Question 3: Characterize the technical accomplishments and progress toward goals.



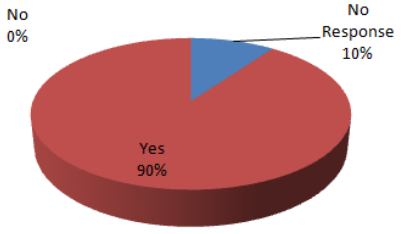
Question 2a: Are the goals of the project technically achievable?



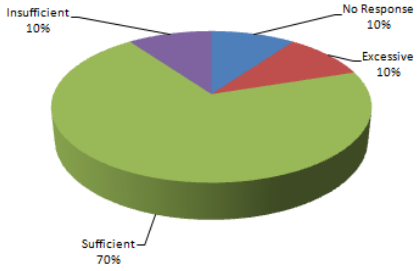
Question 4: How likely is the project team to move technologies into the marketplace?



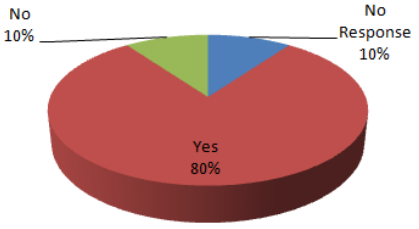
Question 2b: Have the technical barriers been identified and addressed?



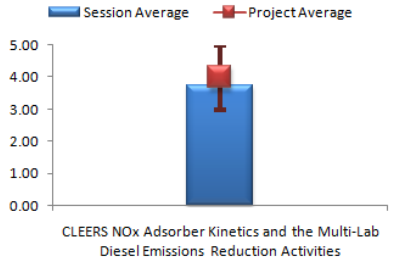
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



CLEERS: Benchmark Kinetics for NOx Adsorbers and Catalyzed DPF (Richard Larson, of Sandia National Laboratories)

Reviewer Sample Size
This project had a total of 10 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that any reduction in NOx emissions via active aftertreatment provides potential to break the traditional BSFC - NOx tradeoff. The reviewer adds the consortia based, non-competitive based approach moves the industry/academia forward in a collaborative way - the end result is better thermal efficiency. The reviewer also stated that there were quantified targets, so they were definitely achievable. A reviewer stated that these were basic studies to understand the underlying mechanisms.

One reviewer commented that these were wide temperature ranges to a minimum fuel penalty. Another reviewer commented that these were the right subject area to enable diesel engines. A reviewer stated that better fundamental understanding of NOx adsorbers and DPF will lead to more efficient emission control devices and ultimately reduced petroleum consumption. Another reviewer commented that the fundamental elemental reaction mechanism will help to speed up LNT technology adoption in industry.

A reviewer commented that NOx catalysts are essential to dieselization. The reviewer continued that details of LNT storage/release are still uncertain. The reviewer requested that the program please emphasize what it is doing that is not being done at other places doing LNT models (Lund, University of Michigan, industrial partners, etc.) Also, the reviewer suggested, full reductants like diesel HCs should be added. Another reviewer felt that the activity must be high after appropriate aging. The LNT durability changes significantly. The reviewer added therefore, the kinetics must adapt with aging conditions (thermal and/or sulfated).

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer believes that with this being a consortium-based program, deployment is essentially automatic. The reviewer adds that the steering committee has a heavy industry focus including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer continues that DOE may want to consider having a similar consortia operating for other research and development programs to enable or accelerate deployment.

A reviewer commented that the technical knowledge gaps have been identified. The right tools are being applied to closing the gaps. Another reviewer commented that it will be useful to study a newer catalyst if/when it is available. Another reviewer saw correlation to experimental data from ORNL. The reviewer added that the Umicore GDI is now on market; the model was transferred to CLEERS members. The reviewer adds that the tool is capable for use in “what if” scenarios and those activities for the upcoming year are focused on appropriate barriers for LNT.

One reviewer stated that ignoring the reality of the application severely limits the eventual usage of the technology. The reviewer commented that flow distribution and local inlet chemistry is important. The reviewer also cautioned that the fundamentals also need to be done here, but added that they felt the pseudo-state technique is very applicable, at least insightful.

A reviewer felt that the questions are not directly applicable but the implied answers are given. One reviewer commented that it was not clear from the presentation how this effort is differentiated from or is taking advantage of the other micro-kinetic modeling efforts and similar experimental work reported in the literature.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer stated that they thought this topic and collaboration of detailed kinetics to the measured data from ORNL is one of the original ideas of CLEERS and expectations. The reviewer added that it took a long time to generate this result, but the results have been published and disseminated. The reviewer continues that from the presentations it is hard to gauge how effective the results are, but it appears from the slides that the original expectations were met. The coordination of the different sciences, national laboratories, and industry is the key technical accomplishment. The reviewer continues that the results appear to be preliminary, with some basic comparison data still showing differences, but the work should continue. The reviewer comments that meanwhile the technologies have hit the market, so there is a time gap between generating the knowledge and having to apply the knowledge, just another reason to keep the collaborative work going.

One reviewer felt the need for fundamental understanding is helpful. Another reviewer commented that the model showed reaction species on catalyst surface for 100-500°C and showed reaction kinetics semi quantitatively. The reviewer added that the model generally gave a good picture of reaction and products; however, the details with the adsorber present needs more resource or time to work it through.

A reviewer stated that they did not catch the capability of the model to predict the extent of the DeNOx event, to determine the remaining NOx storage capacity and subsequent NOx adsorption event.

It was said by a reviewer, that the sulfur effects need to be added along with thermal degradation issues. The reviewer added that timely results are needed, or other organizations will do it. One reviewer noted that while the project title is "Benchmarking kinetics for NOx adsorbers and catalyzed DPF", all activities so far and upcoming plans seem to focus on the NOx adsorber. The reviewer added that shifting the focus to the catalyzed DPF may improve the likelihood of technology transfer and market transformation resulting from this project.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer states that with this being a consortium-based program, deployment is essentially automatic on all levels (from what we learn of the hardware, to the diagnostic methods, to the cross-fertilization of the different technical discussions, to other insights into the underlying physics). The reviewer adds that the steering committee has a heavy industry focus - including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer suggests that DOE may want to consider having a similar consortia operating for other R&D programs to enable or accelerate deployment. The reviewer felt that CLEERS is not really developing specific aftertreatment technologies that would apply to an engine, rather it is using standard commercially available catalysts to develop better understanding and methodologies, in DOE's diverse portfolio, and that this is an excellent program. The reviewer suggests that more opportunities for this approach should be applied to other programs if possible to further enhance deployment.

A reviewer felt that this was a good evaluation for such a basic research effort. Another reviewer stated that the preliminary results are already transferred to industry. One reviewer stated that this will eventually be integrated into better actual application models.

It was commented, by a reviewer, that LNT is one of the lean deNOx technologies, especially for gasoline engines or light duty diesel engines. One reviewer felt that resolution of NOx adsorber issues is not very likely.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer stated that funding appears to be close to the minimum running level of a National Lab researcher, so it would seem that collaborative synergy is being achieved between the National Labs. The reviewer cites running tests at ORNL, combined simulation/testing at PNNL and detailed kinetics at SNL. The reviewer believes that the return on investment is good, as long as the data/methods are being disseminated.

It was stated by a reviewer that funding of $250,000 seems to be at the right level, especially if focus shifts to catalyzed DPFs. Another reviewer felt that this project has a good sense of practical application, and the reviewer believed the project should see increased funding.

A reviewer felt that more experiments need to generate enough evidence for elucidating the reaction mechanisms, the reviewer felt that more resources or time required. Another reviewer would like to see the addition of aging, and other reductants. The reviewer believed this could be useful if funded.

One reviewer added what they described as a general comment that applies to the funding and projects carried out by the National Laboratories. The reviewer adds that there seems to be a tendency to duplicate the core competency at more than one site. The reviewer gives the example of catalyst modeling possibly duplicating work between ORNL, PNNL and SNL. The reviewer believes it would be beneficial to have a clear core competency portfolio.

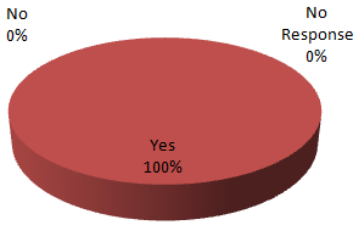
Another comment made by a reviewer was that this is a general comment database for the National Laboratories with distinct differentiation of respective core competencies. The reviewer continues that ensuring complementary suits of core competencies and minimizing duplications will enhance DOE, VT and NL mission and improved the efficiency of funding utilization!

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

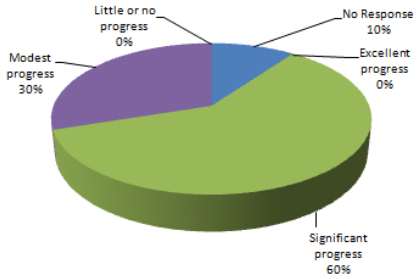
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: CLEERS: Benchmark Kinetics for NOx Adsorbers and Catalyzed DPF

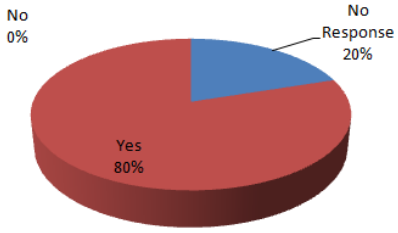
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



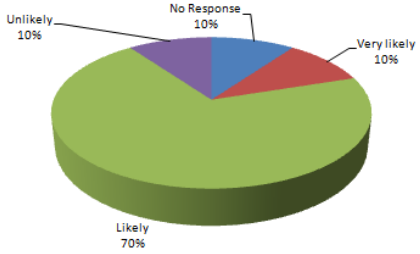
Question 3: Characterize the technical accomplishments and progress toward goals.



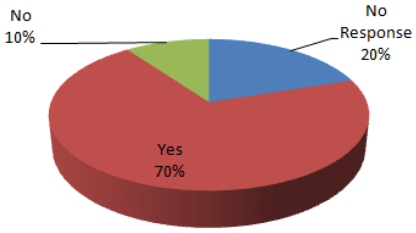
Question 2a: Are the goals of the project technically achievable?



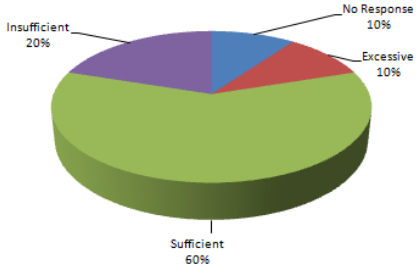
Question 4: How likely is the project team to move technologies into the marketplace?



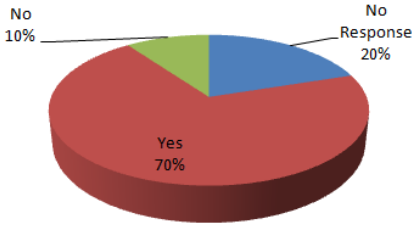
Question 2b: Have the technical barriers been identified and addressed?



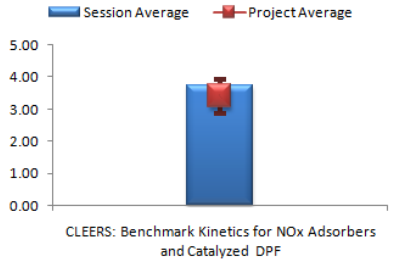
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Controlling NOx from Multi-Mode Lean DI Engines (Jim Parks, of Oak Ridge National Laboratory)

Reviewer Sample Size
This project had a total of 3 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer states that NOx aftertreatment and combustion work, especially as integrated in this project, serves the DOE goals. The reviewer adds that the integration may be best suited to an OEM with more control of ECM, FIE, LNT controls and hardware. The reviewer continues that ORNL is covering a lot of basic development (EGR/combustion/engine hardware) and believes that this is really what OEMs do best - this is not a good topic for ORNL activity. The reviewer found the LNT activity very interesting, and stated that it was valuable to show the basic characteristics. The reviewer adds that they believe this is what national labs do best. One reviewer says that both projects address important needs. Another reviewer said the project focus on the light duty diesels, which assume the system costs, will be acceptable for this market sector. Another reviewer states that the objective is directly related to VT and nicely fits into core charter. The reviewer continues that technology deployment aspects are in focus as the research work covers fundamental characterization to engine testing with HECC. A reviewer says optimized integration of novel combustion regimes with various aftertreatment devices can have a significant effect of reduction of petroleum fuel use.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
Another reviewer comments that there was excellent bridging of fundamental/basic research all the way to real-life applications. A reviewer suggests that there seem to be so many possible avenues that the objectives and goals are not clear. The reviewer continues that many good things can be done, and cites a need to focus on what the funding can cover. The reviewer ends by stating that desulfation and durability were not mentioned very much. One reviewer mentions a broad look at various emerging HECC approaches as combined with a gamut of aftertreatment devices. One reviewer states that this program is building up on several key strengths of FEERC, including extensive experience with laboratory testing of NOx adsorber materials, engine combustion expertise and advanced gas analytics.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
A reviewer states that it seems a lot of activity is on hardware/EGR tuning/development/deposits. The reviewer sees a reliance on obsolete hardware as a problem, and states the move to GM engine is good. One reviewer mentions that technology deployment aspects are in focus as the research work covers fundamental characterization to engine testing with HECC. A reviewer says that many useful results characterizing engine operating points (mostly low-speed low-load) under conventional and HECC combustion regimes. One reviewer felt that it was good work, but wondered whether OEMs have similar data internally. The reviewer still felt that the public and published data is very valuable. Another reviewer adds that an outstanding volume/quality of complementary experimental data related to the impact of various combustion modes/strategies on the operation of a NOx adsorber catalyst. The reviewer continues that the project includes a healthy mix of applied research (on-engine evaluation supported by the advanced gas analytics), in-depth lab research (bench-scale tests) and even some exploratory work (testing of some advanced concept catalysts from University of Kentucky).

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer states that development is probably behind the OEMs, so either the project must accelerate the activity and use more sophisticated methods or alter the focus to specialize on a more specific aspect of controls integration or LNT/HECC optimization. The reviewer adds that the scope of activities may be too broad. A reviewer states that this project provides an important addition to the set of HECC combustion projects, by looking at the implications for the selection of appropriate emission control technologies.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

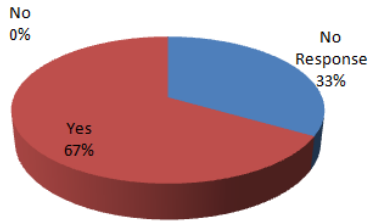
A reviewer states that funding seems insufficient. The reviewer suggests additional funding, if provided, should be used for accelerating introduction of SCR and DOC devices to the test matrix.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

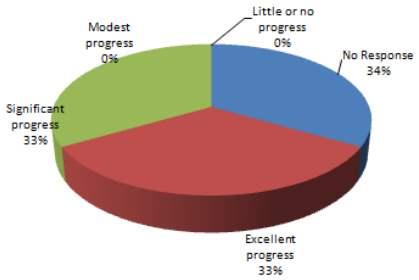
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Controlling NOx from Multi-Mode Lean DI Engines

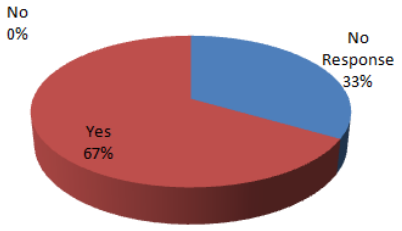
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



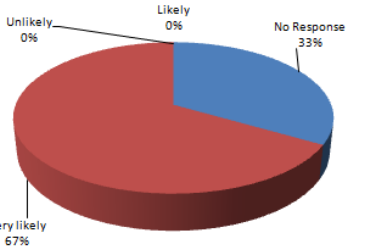
Question 3: Characterize the technical accomplishments and progress toward goals.



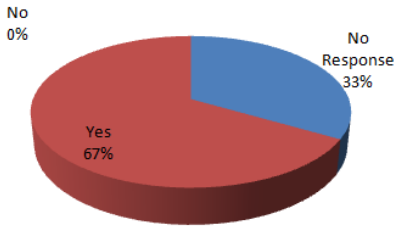
Question 2a: Are the goals of the project technically achievable?



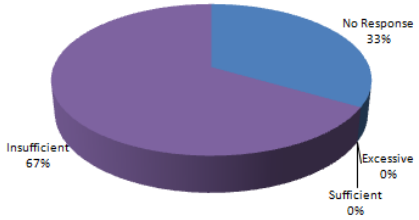
Question 4: How likely is the project team to move technologies into the marketplace?



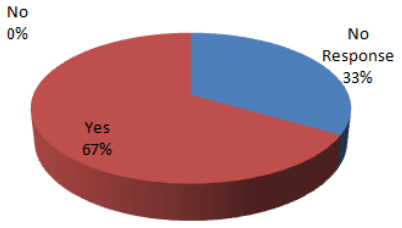
Question 2b: Have the technical barriers been identified and addressed?



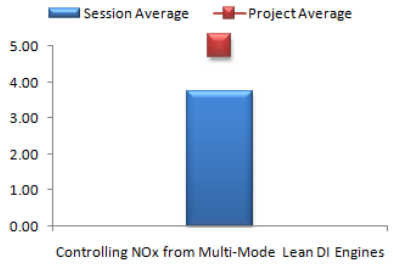
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Coordination of Cross-Cut Lean Exhaust Emission Reduction Simulation (CLEERS) Project (Stuart Daw, of Oak Ridge National Laboratory)

Reviewer Sample Size
This project had a total of 9 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that any reduction in NOx emissions via active aftertreatment provides potential to break the traditional BSFC - NOx tradeoff. The reviewer adds the consortia based, non-competitive based approach moves the industry/academia forward in a collaborative way - the end result is better thermal efficiency. Another reviewer felt that the program was valuable for coordination, adding that various companies cannot communicate easily and that CLEERS creates a forum where communication can occur. A second reviewer also felt that it is important to keep interacting with all cross sections of the emission industry.

A reviewer commented that the diesel engine is one of most promising options to boost fuel efficiency. The reviewer continues that the key issue is emission control for diesel engines to meet Tier 2 Bin 5 standards. The reviewer believes that the program has identified and addressed two big emitters (PM and Lean NOx). As the program moved on, lean deNOx has been identified to be most critical. The reviewer sees the setting up of an industry-wide network to address the technical issues.

Another reviewer says that the program is focused on system cost management and fuel consumption effects while meeting emissions regulations. The reviewer adds that the LNT model adapted for hybrid powertrain systems (Mercedes 1.7L diesel) demonstrates good system integration with another future technology set. R&D survey results were used effectively help align objectives.

A reviewer states that VT cannot be done with its work without addressing emission control and adds that emissions have an associated energy penalty. Another reviewer states that the influence of emission control technologies on transportation fuel use is significant and growing, due to continually tightening emission regulations.

One reviewer comments that the mathematical modeling of the aftertreatment system is a key to their optimization for improved fuel efficiency. Another reviewer states that there is a clear line of sight with DOE's vision of emission reduction with the key advantage of fuel reduction.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer believes that with this being a consortium-based program, deployment is essentially automatic. The reviewer adds that the steering committee has a heavy industry focus including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer continues that DOE may want to consider having a similar consortia operating for other research and development programs to enable or accelerate deployment.

A reviewer believes that the broad industry-government nature of the CLEERS organization should ensure rapid deployment of useful results. Another reviewer states that confidentiality is always a barrier, but CLEERS has done a good job balancing this. Another reviewer saw great team work and partnering of talents with industry and government talent. A reviewer states that the overview provided clear strategy and roles of the participating labs.

One reviewer felt that this was a continuous crosscut activity and that some question elements are not applicable to the project. The reviewer wondered is there a rationale for review of the CLEERS charter since the focus is now on more deployment rather than basic research. Another reviewer stated that the small focused group with monthly meetings is the optimal way to address the technical issues, coupled with annual technical reviews.

A reviewer felt that the overall CLEERS program is addressing several aspects of the aftertreatment technology. The reviewer listed mathematical models of aftertreatment devices, in the pre-competitive form, experimental information critical for developing such models or discriminating different modeling approaches, and that it serves as a channel for technical discussions among the participants and as a conduit for delivering select best external research information to the CLEERS participants. The reviewer added that CLEERS represents a very good example of complementary collaborative work between different National Labs, especially ORNL (FEERC) and PNNL.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer stated that CLEERS is more focused on methodologies and deployment, rather than on specifically overcoming the identified technical barriers. The reviewer adds the opinion that deployment aspects of coordinating National Lab and academia towards industry needs will continue to pay increasingly significant dividends over time. The reviewer thinks this approach deserves a spot in DOE strategy.

A reviewer also says that it seems the CLEERS collaborative process works but believes it also slows down the rate of progress for the initial iterations. The reviewer theorizes that perhaps over time the speed will also increase. This is one disadvantage of collaboration, but the results are released over a broad spectrum of industry/groups. The reviewer thinks this more than offsets the time related disadvantage.

One reviewer states that CLEERS activities tend to over-emphasize gasoline technologies over diesel technologies, specifically, the results of the survey showed DPF and SCR related issues as top diesel priorities, and LNT issues as top gasoline priorities. Yet, four out of five presented projects (8746, 8744, 10049, 14766) are devoted to LNT, only one to DPF (10048) and none to SCR.

Another reviewer comments that overall, CLEERS has substantially outgrown its original role and scope and evolved into a collaborative technical research team (as witnessed by the individual CLEERS presentations ranked separately) and also a focused technical forum.

One reviewer lists LNT modeling progress and R&D priorities survey incorporated into PNNL, ORNL, and SNL operating plans. A reviewer states that simulation is an extremely robust and useful tool when used properly. Another reviewer states that the program has the necessary talent and group to accomplish the goals by a rigorous incorporation of a large group.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer states that with this being a consortium-based program, deployment is essentially automatic on all levels (from what we learn of the hardware, to the diagnostic methods, to the cross-fertilization of the different technical discussions, to other insights into the underlying physics). The reviewer adds that the steering committee has a heavy industry focus - including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer suggests that DOE may want to consider having a similar consortia operating for other R&D programs to enable or accelerate

deployment. The reviewer felt that CLEERS is not really developing specific aftertreatment technologies that would apply to an engine, rather it is using standard commercially available catalysts to develop better understanding and methodologies, in DOE's diverse portfolio, and that this is an excellent program. The reviewer suggests that more opportunities for this approach should be applied to other programs if possible to further enhance deployment.

A reviewer felt that the CLEERS format ensures close industrial involvement and participation at all stages, from determining the research direction (e.g. via industry surveys) to information dissemination via monthly teleconferences and an annual workshop.

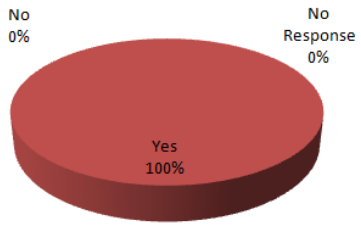
A reviewer felt that industry and academic people are active in the group. Another reviewer saw good connection to research and development throughout the survey. One reviewer felt that teaming and information dumps are critical and being addressed well in this program. One reviewer felt that the CLEERS projects would prove useful to the gasoline technologies of automotive companies, but not very useful for diesel (especially heavy duty).

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
Reviewers suggested keeping the government-sponsored staff at the same level, or reduce it. The reviewer also felt that industry should continue to pitch in. The reviewer added that administrative overhead should be reduced and the tendency to increase the home grown staff assignments at ORNL, PNNL, etc. should be resisted. One reviewer felt that some LNT activities at ORNL, PNNL and SNL seem overlapping. A reviewer believes the CLEERS return on investment is very good due to the collaborative approach and the focus on methodologies and base understanding over developing new hardware.

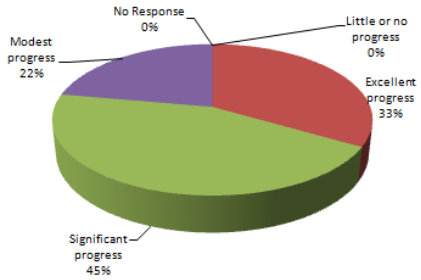
Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Coordination of Cross-Cut Lean Exhaust Emission Reduction Simulation (CLEERS) Project

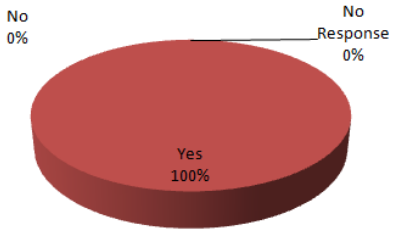
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



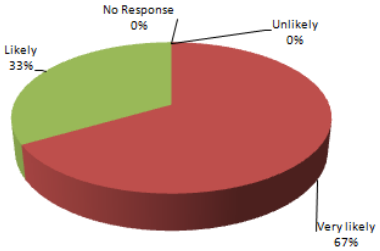
Question 3: Characterize the technical accomplishments and progress toward goals.



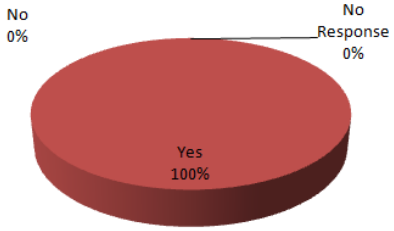
Question 2a: Are the goals of the project technically achievable?



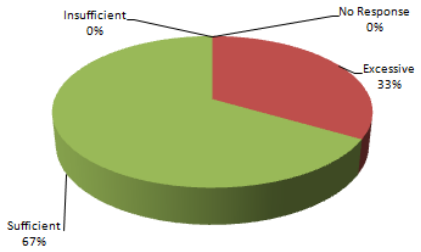
Question 4: How likely is the project team to move technologies into the marketplace?



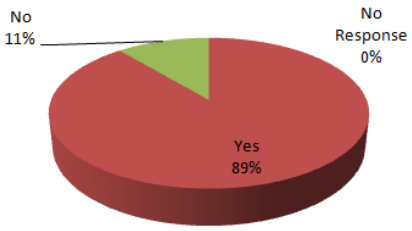
Question 2b: Have the technical barriers been identified and addressed?



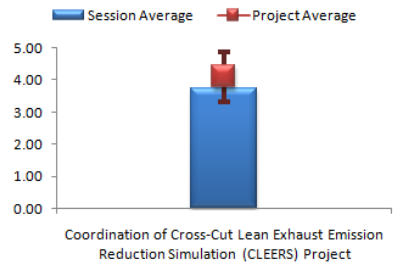
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Degradation Mechanisms in Advanced Catalysts for Urea SCR (CRADA with General Motors) (Charles Peden, of Pacific Northwest National Laboratory)

Reviewer Sample Size
This project had a total of 2 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer states that selective catalytic reduction is a key issue in applications.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
No comments were received for this query.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
No comments were received for this query.

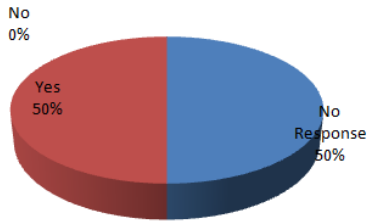
Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.
No comments were received for this query.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
No comments were received for this query.

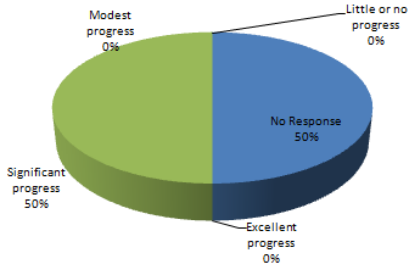
Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Degradation Mechanisms in Advanced Catalysts for Urea SCR (CRADA with General Motors)

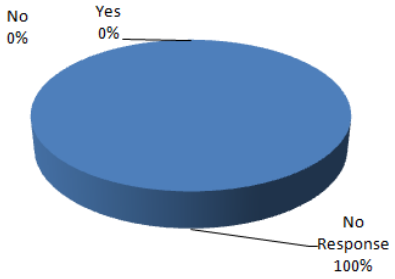
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



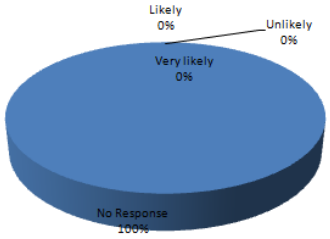
Question 3: Characterize the technical accomplishments and progress toward goals.



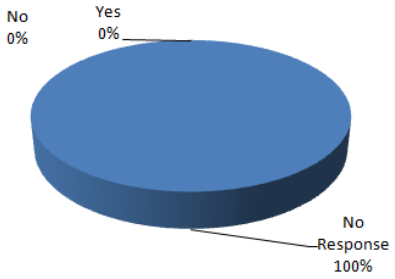
Question 2a: Are the goals of the project technically achievable?



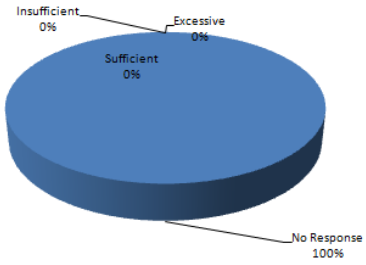
Question 4: How likely is the project team to move technologies into the marketplace?



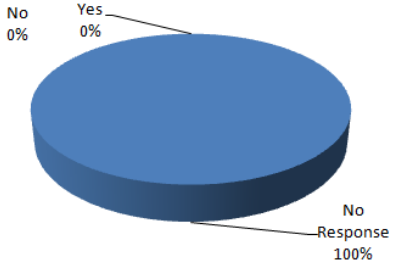
Question 2b: Have the technical barriers been identified and addressed?



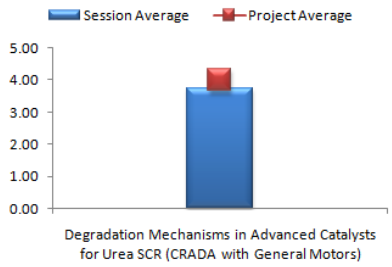
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Diesel Soot Filter Characterization and Modeling for Advanced Substrates (CRADA with DOW Automotive) (Darrell Herling, of Pacific Northwest National Laboratory)

Reviewer Sample Size
This project had a total of 10 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer commented on the minor impact on BSFC/MPG by advancing that substrate state of the art. Another reviewer stated the project helps enable automotive diesel technology, and one reviewer added that DPFs are needed for diesel engines. One reviewer felt that this was a technology transfer of CLEERS technology, and seems to be capable of catalyst design to potentially improve the DPF technology state of the art. The reviewer continues by noting that successful application and refinement over time could have a more significant impact. A reviewer commented that this was a nice technical CRADA with Dow. One reviewer stated that alternative materials provide low backpressure characteristics compared to other types of filters. It was also said, by a reviewer that advanced DPF substrates can deliver lower pressure drop across the device, and/or improved filtration efficiency, thereby reducing petroleum use by modern diesel engines. Another reviewer wondered why this material (Dow ACM) was chosen (lower back pressure). The reviewer also wondered about durability.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer commented that there were no quantitative targets, so R&D will generally move the project forward. The reviewer felt it is not really possible to gauge success. Another reviewer stated that there was the right mix of analytical (modeling) and experimental tools applied to characterization of advanced filter substrates. Another reviewer stated that the concentration of catalyst is very extreme on the leading edge. One reviewer said that using this different, not a monolithic DPF, is very important in order to understand the breadth of technologies that might be in the marketplace.

A reviewer commented that Dow acicular mullite micromodeling was used to make higher level models more robust by understanding fundamentals. The reviewer added that digitized re-construction was based on 2D images and a stochastic approach, and that this was building upon single channel understanding. The reviewer stated that it was difficult to account for needles/soot interactions, but is trend correct; i.e., filtration efficiency benefit? The reviewer continued that little known/presented on cost of ACM and control of mictrostructure uniformity (extrusion effects on needle morphology).

One reviewer stated that it was within the confines of CRADA, while another stated that this was results reporting, but that the technique to describe the needles is very interesting.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
A reviewer stated that there were no quantitative targets so R&D will generally move the project forward, but it is not really possible to gauge success. The reviewer added that the results presented included 2006 results, but that results for 2007 seemed limited.

Another reviewer wondered about durability after active soot regeneration events. The reviewer was also interested in knowing the maximum temperature limit of the material. The reviewer questioned

what the limitations of this filter were compared to others in the market. The reviewer showed concern about durability and wondered what happens when large amounts of HC enter the filter during active filter regeneration.

A reviewer saw a good correlation of simulations under the CLEERS programs on cordierite. The reviewer felt that tailored microstructures show promise. Another reviewer felt that there was good advancement in a uniquely-tailored CRADA for Dow's material. Another reviewer felt that the preliminary modeling results seem to be validating fairly well against available data. One reviewer stated that the talent and the tools are in place in order to achieve the goal.

One reviewer felt the project had not shown a lot of insight yet, while another stated the project has come to a close.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer stated that this CRAD seems to be applying the technology PNNL developed within the CLEERS DPF project, so this project is in itself a technology transfer/market transformation. Another reviewer stated that Dow Automotive is a partner; communication also through CLEERS, while another stated that Dow will evaluate the technical feasibility and market potential. One reviewer stated that, considering that the project is a CRADA with an industrial partner (Dow), it is very likely that useful results of this research will be commercialized.

One reviewer felt that the mullite material has great potential, and studying it in detail is the correct thing to do. A different reviewer stated that the needle-like structure provides good back pressure behavior, however, lower on filtration efficiency is a big concern as well as the material's safety issue. Another reviewer thought the project assumes ACM cost can be competitive.

A reviewer believed there was way too much Pt loading (120g/ft^3), and suggested the project try <15g/ft^3.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

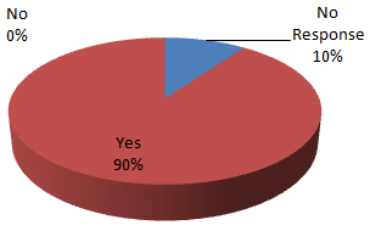
One reviewer stated that is was the final year of the CRADA. Another reviewer felt Dow should be matching the funding. A reviewer believed that funding of $150,000 seemed sufficient, considering the CRADA partner is funding the same amount. A reviewer suggested exploring the possibility of using the filters for 4-way applications.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

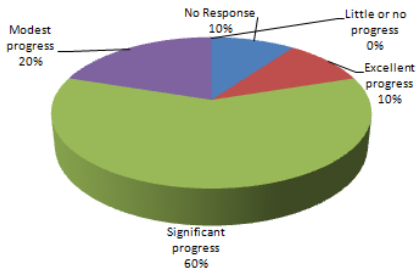
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Diesel Soot Filter Characterization and Modeling for Advanced Substrates (CRADA with DOW Automotive)

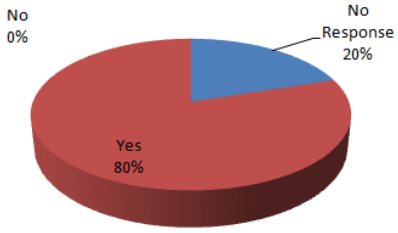
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



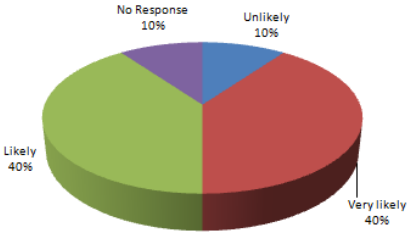
Question 3: Characterize the technical accomplishments and progress toward goals.



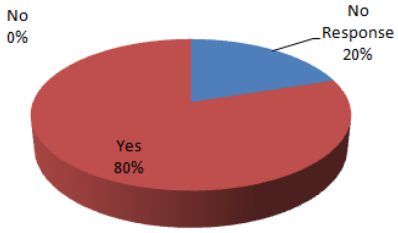
Question 2a: Are the goals of the project technically achievable?



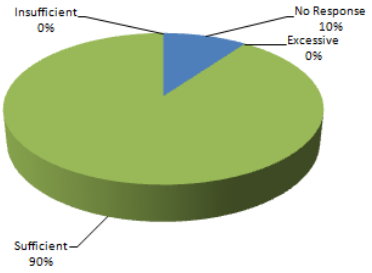
Question 4: How likely is the project team to move technologies into the marketplace?



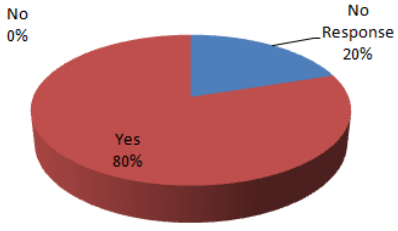
Question 2b: Have the technical barriers been identified and addressed?



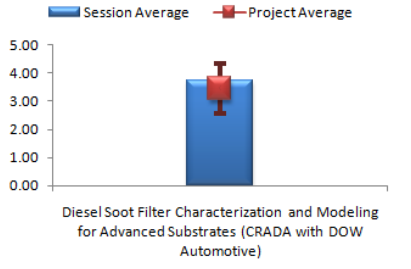
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Investigation of Aging Mechanisms in Lean NOx Traps (Mark Crocker, of University of Kentucky)

Reviewer Sample Size
This project had a total of 10 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer cited a nice parametric look at Ce LNT washcoats and felt it would be advantageous to target higher benefit washcoats for subsequent work. Other reviewers cited an improved understanding of LNT chemistry that may lead to reduced petroleum use by the engines that will use LNT for NOx aftertreatment.

Another reviewer mentioned that the project was aimed at durability improvements and optimized catalyst performance over aging history via compositional changes. One reviewer believed that LNT aging has been identified to be a major barrier before commercialization. The reviewer adds that a fundamental LNT catalyst study at chemical and physical processes level to study aging effect is highly desirable. The reviewer continued that for a real catalyst, the function of each component for catalyst performance as well as durability and their synergic interactions are highly sought after for better design catalysts and engine operation. The reviewer said that this project squarely addresses the key issues regarding to the LNT catalysts.

One reviewer said that the work is worthy of support. The reviewer asked is there a rationale for continued funding of this program by VT since the focus now is on more deployment rather than basic research. The reviewer wondered should it be funded from Basic Science instead. Another reviewer felt the work was somewhat repetitive of earlier work by other authors.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer commented that for the first review the data presented looks very good. The reviewer felt the next step is aging of LNT catalysts. The reviewer found the approach to be sound, and saw good collaboration with OEM. A reviewer felt that testing aged catalysts is important. The reviewer was glad the work respects this. The reviewer also noted that varying the LNT formulation composition is different than everyone else which tend to treat the catalysts as black boxes.

A reviewer noted good progress with ceria additions showing multiple benefits including low temp conversion efficiencies, storage capacity, and desulfation. The reviewer notes progress with LNT aging on a bench reactor to optimize catalyst performance over aging cycle.

A reviewer commented that the project addresses a real-life issue and a product development hurdle. The reviewer adds that the project seems to capitalize on a specific core competency to help industrial partners. Another reviewer felt that these model catalysts are much more representative than past (simpler) model catalysts.

A reviewer stated that the project plan, experimental facility and selection of research areas, is complementing work done in the National Labs. Another reviewer saw this as an excellent comprehensive study of the effects cerium has on LNT performance, the reviewer added that this was a “beautiful study.”

Another reviewer states that with knowledge of commercial catalyst components, the project addresses the role of each individual components and effects on aging characteristics by using bench top reactor in simulated gas stream, and DRIFTS and oxygen storage capacity measurements. The reviewer continues that after aging, the catalysts were studied again. The reviewer states that the current work appeared to focus on OSC impact to LNT and on aging.

A reviewer comments that the program is focused on one aspect of NOx adsorber technology which has not been well characterized (at least that knowledge is not available in the public domain) - the relationship between the catalyst formulation and various aspects of its performance. The reviewer continues that the program systematically explores key formulation variables and uses solid experimental protocols to evaluate these.

A reviewer wonders how this project is fundamentally different than the CRADA work at PNNL on LNT degradation. PNNL was also getting into fully formulated catalysts. The reviewer adds that the SpaciMS continues to show usefulness.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer comments that this is the first review for this work, but already a lot of good conclusions/findings are being communicated. The reviewer adds that there is excellent return on investment. One reviewer stated that many useful results were already obtained, specifically in the area of catalyst selection and desulfation mechanisms. A third reviewer stated that the project, in its first year, already had substantial numbers of formulations prepared at University of Kentucky and characterized at ORNL and Ford. A reviewer felt that there had been excellent progress for a first review, but would like more information on cost impact (i.e. the reduction of precious metal content).

One reviewer cited the work with fully formulated catalysts and the realistic lab simulations. Another commented on the interesting data for a useful range of formulations. The reviewer added that data on aged pieces will be very interesting. Another reviewer commented that studying composition changes helps identify formulations that may remove the technical barriers.

Reviewers focused on the Ce addition into the catalyst improving catalyst performance, selectivity to N_2, aging and regeneration. A reviewer adds catalyst characterization tools appeared to be more OSC specific. The reviewer said its other synergistic catalyst function needs are to be emphasized as desired. The reviewer felt it was desirable to see more spectroscopic study on the catalysts, to see where sulfur is stored, what surface interaction with Ce is seen, and how much OSC is affected by stored sulfur before and after aging. The reviewer would like to see more microscale study on the catalysts as the project is carried by academia. Reviewers believed that Ford had an internal aging protocol 4-5 years ago, and why do it again. The reviewer also wondered if real exhaust was used.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

Progress was seen to be good for a first year project. Good ties to Ford and Umicore were also cited, and it was believed this would lead to technology transfer. A reviewer added that the fundamental study will have direct impact on catalyst formulation. The reviewer continues that with an OEM as a partner, the learning from the study will likely to be implemented if a commercial value is proven.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

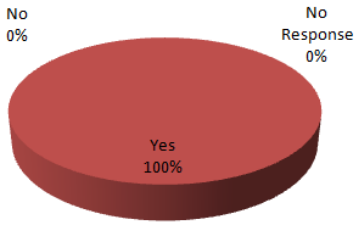
A reviewer felt that additional funding would be made available based on the successes of the first year. The reviewer added that it seems commensurate if most of the work is performed at UK. A reviewer wondered what the total budget of this excellent effort was, including the partners contribution. Another reviewer felt the funding seemed adequate considering the project's complimentary nature to many other LNT research projects funded by VT. One reviewer felt that current funding was insufficient.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

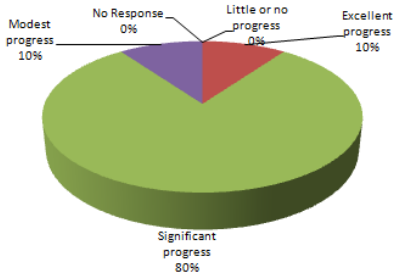
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Investigation of Aging Mechanisms in Lean NOx Traps

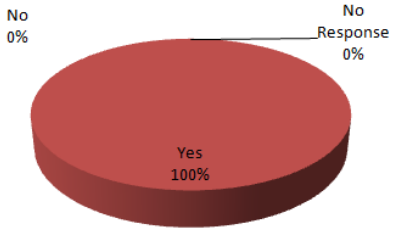
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



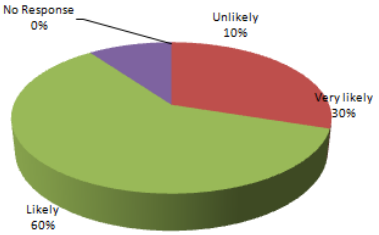
Question 3: Characterize the technical accomplishments and progress toward goals.



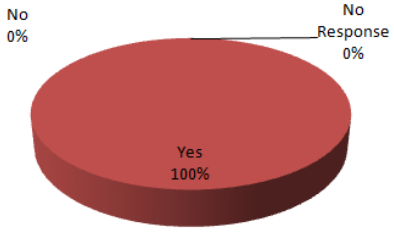
Question 2a: Are the goals of the project technically achievable?



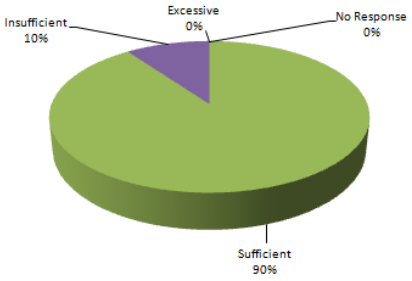
Question 4: How likely is the project team to move technologies into the marketplace?



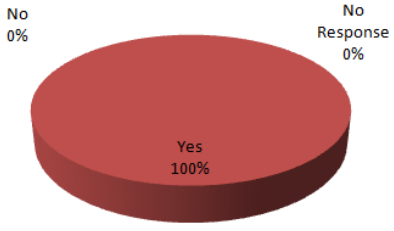
Question 2b: Have the technical barriers been identified and addressed?



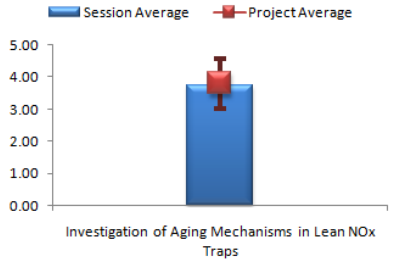
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Kinetic and Performance Studies of the Regeneration Phase of Model PT/RH/Ba NOx Traps (Mike Harold, of University of Houston)

Reviewer Sample Size
This project had a total of 10 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer felt that an advantage seems to be a unique approach toward looking at LNT washcoat chemistry and kinetics. The reviewer is not sure how effective the modeling data is (kinetics) but it would seem that the data developed makes a good database for follow-up investigation. The reviewer wondered if there were follow-up investigations underway. A reviewer commented on diesel engine market penetration and fuel efficiency. The reviewer also noted an excellent graphic on the Houston skyline which emphasized the impact of the project.

A reviewer stated that the work is worthy of support, but wondered if there is a rationale for continued funding of this program by VT since the focus now is on more deployment rather than basic research. The reviewer also wondered whether the project should be funded from Basic Science instead, since it is in the third year of a four-year program.

A reviewer stated that LNT catalysts are necessary for diesel and probably mixed-mode gasoline engines. A commenter noted that better understanding of LNT processes, including better modeling tools for LNT design optimization, can lead to lower petroleum use by the engine that will use such devices.

One reviewer said that this program is far more rigorous in molecular modeling and fundamental than any of the CLEERS-related programs.

One reviewer said that a predictive LNT reactor model is required to have main chemistry and transport processes for fundamental understanding, and suggest design the catalysts and operate engine to fit catalyst requirement. The reviewer suggests fundamental studies on transient kinetics and LNT regeneration, evaluating and compare the reductant performance, design and optimize predictive model based on experimental data, and test the newly designed LNT on a HDD dynamometer. The reviewer states that the project systematically studies fundamental to design practical catalyst system supports the DOE objective for fuel efficiency enhancement.

One reviewer states that early NOx adsorber systems on the market are quite non-optimal and better understanding of this technology should lead to improved fuel efficiency.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer found the approach to be unique. Another reviewer felt the project addresses a real-life issue and a product development hurdle. The reviewer adds that the project seems to capitalize on a specific core competency to help industrial partners.

Another reviewer comments that a symbiotic relationship between experimental studies and modeling efforts creates a good basis for reaching better understanding of LNT performance, allowing better design and integration of LNTs.

One reviewer considers this to be the most promising of all the other LNT modeling programs which are too phenomenological and empirical. The reviewer adds that this program is excellent and sets the bar much higher than the other CLEERS programs.

The microkinetic approach was seen as approaching incorporation into reactor models in a joint project with Ford and BASF catalysts. TAP reactor seems very sophisticated to get fundamental understanding of reactions using actual monoliths rather than powders; provides excellent path to correlate with engine samples. Another reviewer found the work on microkeinetics of LNT useful.

One reviewer commented on the bench-scale reactor system that provides atmospheric pressure reaction in simulated gas exhaust system; the reviewer added that the TAP reactor provides ultra-high vacuum flow transient study for the catalyst and monolith; the reviewer continues that separated catalyst characterization provides information on microscale information over the catalyst surface and the reviewer mentioned the computer for microkinetics and LNT model. The reviewer ended that the computer for dynamometer system provides a testing facility for designed catalyst for evaluation and further improvements.

A reviewer stated that this program addresses several aspects of the NOx adsorber technology which are not covered by any other program in the reviewed portfolio; in particular, it targets to quantitatively de-couple the reaction engineering aspects of the NOx storage and regeneration process from the chemical mechanisms. The reviewer continued that the involved set of experimental tools and expertise at UH (including modeling) appears to match well the project objectives.

One reviewer described the project as a great education exercise and wondered if SpaciMS would be of use here.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer said that it was hard to judge technical progress: it could be that barriers have been overcome, but the reviewer was not certain. The reviewer looks forward to seeing modeling next year.

A reviewer states that the reactor results are very encouraging, but 'fundamental' studies can often impede progress toward deployment. The reviewer adds that, for example, the study of the effects of monolith length on ammonia formation was interesting, but the impact on objectives was not clear. The reviewer believes that modeling should focus on clear reduction of costs through formulation optimization.

A reviewer comments that some of the findings made by the program during its first year were very interesting and of practical significance, for example the finding of the difference in the reactivity of NH_3 and H_2 as reductants for NOx regeneration. Another reviewer cites good bridging of fundamental/basic research to real-life product developments.

A reviewer says that the TAP reactor system was applied on model catalysts and provided detailed reaction sequences and separation between diffusion and surface reaction, so that work provided information on intrinsic reaction kinetics. In addition, the temperature of the catalyst is well controlled. The reviewer continues that it is desirable to see the study on real LNT catalysts which has other components for promoting catalyst performance. The reviewer says the TAP study will define the synergy effect of the additive to the LNT model catalysts, which will provide insights to develop new catalysts or new chemistry. The reviewer continues that the benchtop reactor provided information

on catalyst performance in simulated exhaust gas. The reviewer concludes that the fundamental study is hopefully (funding availability) extended to catalyst durability, which is major concern after desulphurization many times for the industrial applications.

A reviewer felt that the project seems to get at the difficult question of the importance of Ba-Pt "intimacy", among other data. Another reviewer feels that this program will yield more useful information then all the previous reviewed CLEERS modeling programs. A different reviewer noted that the modeling had begun.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer needed to see the modeling results to really understand. A number of reviewers cited a strong partnering with Ford and BASF and that this would lead to information dissemination from the project to the marketplace. A reviewer added that there was a strong history of publication, citing both DEER and SAE. A different reviewer also listed the 'synergistic studies' with State of Texas for retrofit, Houston; pull from HD side of market. The project was described as relevant work by a reviewer. One reviewer commented that by working closely with a catalyst coater and an OEM, the knowledge developed from this fundamental study is readily transferred to the commercial side for new products and applications.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

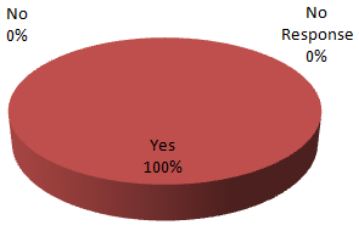
A reviewer stated that more effort is justified for determining the kinetics of various LNT formulation compositions. The reviewer recommends the project team talk with Mike Crocker and obtain his samples that have different Ba, Ce, and precious metals. The reviewer gave the examples of which composition avoids NH_3 and which make more NH_3. A reviewer described the project as university-based research with good support from Ford and BASF. One reviewer wondered what the total budget, including partners contributions were. Another reviewer felt the funding was sufficient, considering the leverage of other funding from the state of Texas.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

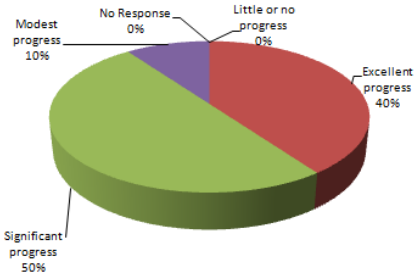
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Kinetic and Performance Studies of the Regeneration Phase of Model PT/RH/Ba NOx Traps

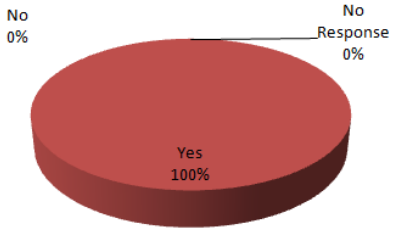
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



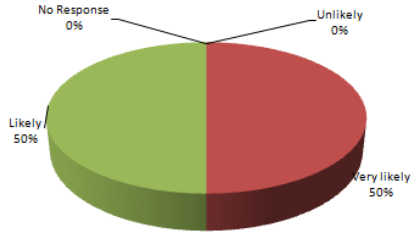
Question 3: Characterize the technical accomplishments and progress toward goals.



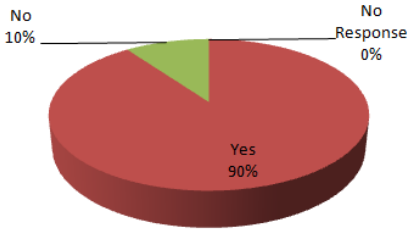
Question 2a: Are the goals of the project technically achievable?



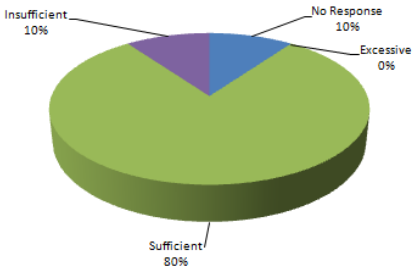
Question 4: How likely is the project team to move technologies into the marketplace?



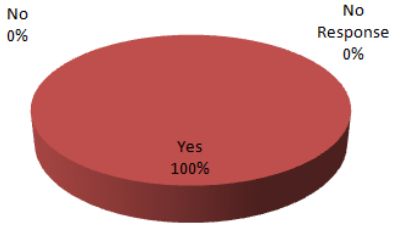
Question 2b: Have the technical barriers been identified and addressed?



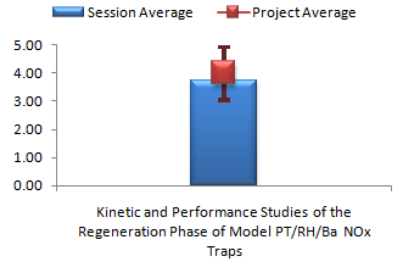
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Measurement and Characterization of Lean NOx Adsorber Regeneration and Desulfation (Jim Parks, of Oak Ridge National Laboratory)

Reviewer Sample Size
This project had a total of 10 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer states that NOx aftertreatment and combustion work, especially as integrated in this project, serves the DOE goals. The reviewer adds that the integration may be best suited to an OEM with more control of ECM, FIE, LNT controls and hardware. The reviewer continues that ORNL is covering a lot of basic development (EGR/combustion/engine hardware) and believes that this is really what OEMs do best - this is not a good topic for ORNL activity. The reviewer found the LNT activity very interesting, and stated that it was valuable to show the basic characteristics. The reviewer adds that they believe this is what national labs do best.

Another reviewer said the project focus on the light-duty diesels, which assume the system costs, will be acceptable for this market sector. Another reviewer states that the objective is directly related to VT and nicely fits into the core charter. The reviewer continues that technology deployment aspects are in focus as the research work covers fundamental characterization to engine testing with HECC.

One reviewer says that both projects address important needs. Another reviewer answers that the work fits the DOE goals by enabling diesel technology introduction that will lower our dependence on oil via higher mpg. The reviewer adds generally this is diesel enabling, and fits the mission of DOE. Another reviewer comments on a better understanding of LNT regeneration and desulfation will help reduce diesel fuel use.

One reviewer mentions the regeneration chemistry and performance of the LNT system and the system performance under multimode engine operation condition is highly relevant to lean deNOx. Multimode operation further improves fuel efficiency for a diesel engine.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer commented that there are no quantitative goals so it is easy to say that the "directional" objectives will be attained. The reviewer suggests that DOE may want to consider requiring quantitative goals to clarify objectives - this is a global comment - not specifically for this work. The reviewer continues that a clear quantitative goal in this project would allow an easier optimization of control strategies between the different combustion modes - the goal would allow a translation between NOx emission and BSFC.

The same reviewer continues that the ORNL project may want to consider modeling the LNT around each combustion point to select the optimal point considering engine-out and LNT efficiency conditions - the LNT activity may alter the optimal point selection and could improve the efficiency level. This reviewer said it was good to note the space velocity impact and advantage of advanced combustion modes - this is an advantage, and adds that it is hard to imagine deployment for the advanced combustion activity. The Ce LNT activity has good potential.

Another reviewer suggests detailing the regeneration events for each different engine approach. The reviewer wonders what the emissions are and the lambda value and profile, such as H_2, CO, and HC.

The reviewer continues that the lower values of NH_3 during HECC should be directly related to the engine-out NOx, especially during the DeNOx event.

A reviewer comments on emissions, durability, and cost being listed as barriers, and suggests that the details for understanding and overcoming the latter two were implied via efficiency as measured by total fuel usage which included LNT. The reviewer continues that well-planned approach coupling LNT with HECC; and good connection to other related initiatives ('bubble slide').

Another reviewer comments that there was excellent bridging of fundamental/basic research all the way to real-life applications.

A reviewer suggests that there seem to be so many possible avenues that the objectives and goals are not clear. The reviewer continues that many good things can be done, and cites a need to focus on what the funding can cover. The reviewer ends that desulfation and durability were not mentioned very much.

A reviewer says that introduction of Ce-based LNT is a useful addition to the scope of the project. Another reviewer mentions a good effort in trying to understand a complex system and different options and the implications that result in areas like coking from EGR. Another reviewer mentions that lots of detail on how to implement is useful.

Another reviewer suggests linkage of LNT performance to a diesel engine operation under multimode is highly desirable. A catalyst system can handle both NOx and high HC and CO under engine operation conditions. One reviewer states that this program is building on several key strengths of FEERC, including extensive experience with laboratory testing of NOx adsorber materials, engine combustion expertise and advanced gas analytics.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer states it seems that a lot of activity is on hardware/EGR tuning/development/deposits. The reviewer sees a reliance on obsolete hardware as a problem, and states the move to the GM engine is good. One reviewer says that there has been good progress on LNT/HECC optimization for efficiency while meeting emissions. The reviewer was still not clear on costs (initial & O/O) and durability effects; e.g., total fuel usage and additional EGR deposits.

One reviewer mentions that technology deployment aspects are in focus as the research work covers fundamental characterization to engine testing with HECC. The reviewer adds that the project addresses multiple emissions reduction barriers in a systematic fashion, and that realistic engine operation, albeit with an "older" Mercedes engine. The reviewer notes the carcass is Mercedes Benz but the NTRC researchers made state-of-the-art hardware out of it. The reviewer also says that the project addressed realistic multi modes. The reviewer ends by saying that the questions of last year's reviewers were thoroughly addressed.

One reviewer felt that it was good work, but wondered whether OEMs have similar data internally. The reviewer still felt that the public and published data is very valuable.

Another reviewer felt that it was hard to access project 9248 since it was presented together with project 12249. The reviewer added that their perception was the LNT work was repeating a lot of previously conducted work, and that the project overlaps with other current LNT related projects.

A reviewer comments that this is basic engine development, and that the results can be used in a sort-of benchmark mode to check engine development. The reviewer adds that HC SCR would be very useful and that the nanotubes idea is great and has a lot of potential. The reviewer believed that noise was an oversight.

A reviewer states that the project explored HECC and LNT synergy and found an optimal operation condition. The reviewer adds that, under heavy EGR, HC coking and deposition in EGR issue needs to be addressed.

Another reviewer adds that an outstanding volume/quality of complementary experimental data related to the impact of various combustion modes/strategies on the operation of a NOx adsorber catalyst. The reviewer continues that the project includes a healthy mix of applied research (on-engine evaluation supported by the advanced gas analytics), in-depth lab research (bench-scale tests) and even some exploratory work (testing of some advanced concept catalysts from U. Kentucky).

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer states that development is probably behind the OEMs, so either the project must accelerate the activity and use more sophisticated methods or alter the focus to specialize on a more specific aspect of controls integration, or LNT/HECC optimization.. The reviewer adds that the scope of activities may be too broad.

Another reviewer commented on the project being well connected with the stake holders and doing relevant work. One reviewer said that there was useful data for OEMs, suppliers and university research, A reviewer mentioned that considering near-term plans in the industry for LNT commercialization, it is likely that whatever improvements can be derived, will be picked up by the industry.

One reviewer felt this was the type of information that advance calibrators use at an engine company. The reviewer adds that the findings about deposits should not be overlooked. Another reviewer states that there is a strong track record for publishing in the high impact/relevance meetings and journals (DEER, SAE, etc) and close ties to CLEERS community. One reviewer assumes the project will develop a stronger partnership with Engine OEM such as Mercedes Benz or GM.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

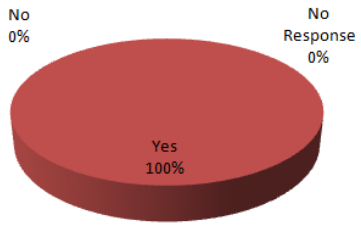
A reviewer suggests considering to do the urea-SCR work before the HC-SCR concept. The urea-SCR concept is more likely to deliver more interest and potential for transfer to industry. Another reviewer suggests that more is better for a wholesome and integrated plan such as this. The reviewer continues that the team core competency is high and should be leveraged with more support. One reviewer states that a faster pace of results would reduce the risk that it only duplicates what industry is doing internally. The reviewer continues that more value would be delivered with a faster effort. The reviewer suggests focus on most important goals so real progress can be made; avoid trying to work on everything all at once. A reviewer mentions that the funding seems excessive, especially considering the large number of LNT projects.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

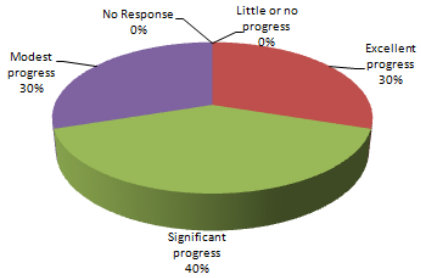
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Measurement and Characterization of Lean NOx Adsorber Regeneration and Desulfation

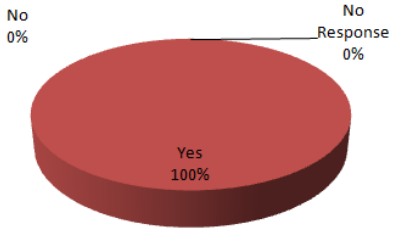
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



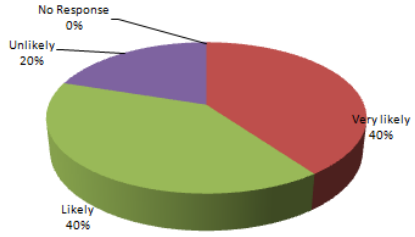
Question 3: Characterize the technical accomplishments and progress toward goals.



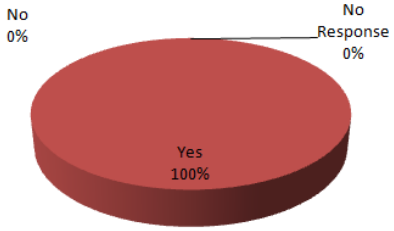
Question 2a: Are the goals of the project technically achievable?



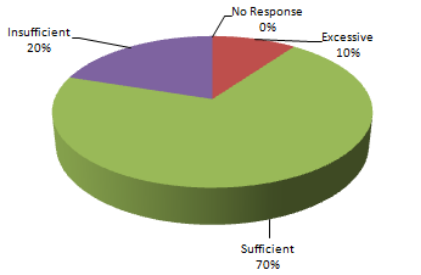
Question 4: How likely is the project team to move technologies into the marketplace?



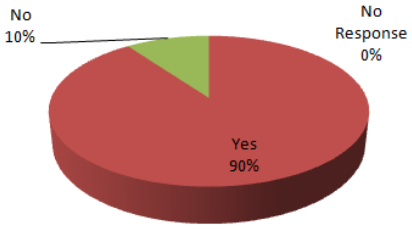
Question 2b: Have the technical barriers been identified and addressed?



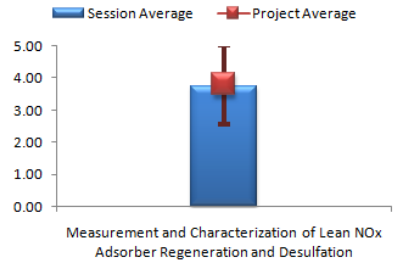
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Mechanism of Sulfur Poisoning of NOx Adsorber Materials (CRADA with Cummins) (Charles Peden, of Pacific Northwest National Laboratory)

Reviewer Sample Size
This project had a total of 8 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that effective LNT technology enables LDT diesel implementation. Another reviewer said that CRADA with Cummins and Johnson-Matthey as a collaborator assumes commercialization of LNT is successful (Dodge Ram) long term to afford lower BSFC. Another reviewer commented on the excellent collaboration with Cummins and Johnson-Matthey via a CRADA.

It was stated, by a reviewer, that NOx catalysts are required for diesel engines. Another reviewer felt that improved understanding of sulfur poisoning of NOx adsorbers is likely to lead to improved aftertreatment devices and their integration, thereby reducing diesel fuel use. One reviewer commented that sulfur poisoning is the key hurdle for LNT catalyst application. The reviewer continued that fundamental understanding is critical for better design catalyst. A reviewer felt that the project was in line with DOE's vision.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer stated that base LNT technology is already deployed, tweaking this via this technology has much potential for this limited application, but more importantly to develop the methodology for designing catalyst systems from scratch. The reviewer believes this would have a huge deployment payoff. A reviewer commented on the great partnering with key CRADA stake holders. The reviewer added that PNNL has the correct high tech analytical facilities to study the degradation mechanism.

One reviewer commented that working directly with a catalyst supplier and OEM seems to be a very effective method to quickly enhance catalyst development. Another reviewer spoke of the forging ahead with the release of the 2007 Dodge Ram truck.

A reviewer saw signs of excellent collaboration bringing first-rate lab capabilities together with industrial partners actively developing consumer products. Another reviewer felt with the application of the state-of-the-art characterization tools it is very likely that the sulfur poisoning mechanism will be better understood through this project. A reviewer stated that there was a fundamental understanding of sulfur degradation: optimum removal strategy before regeneration without significant fuel economy penalty.

A reviewer was unsure if a commercially viable way of easy sulfur removal will be developed in this effort.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
A reviewer stated that five years to look at sulfur deactivation is too long to impact the initial application, since the LNT technology is already deployed. The reviewer found the water impact interesting, but was unsure how to avoid water in any internal combustion engine.

One reviewer commented that giving data and input to Johnson-Matthey has proven to speed up catalyst development. The reviewer added that more CRADA programs should be done this way.

A reviewer stated that optimum processes for removing sulfur through fundamental understanding of reaction mechanisms were developed. The reviewer added the there had been an impressive use of the NSLS facility to identify sulfur species and formation sites, as well as to identify positive and negative effects of water. The reviewer wondered what the recommended resolution is, since water is always present in exhaust.

A reviewer noted that the value is reflected by the apparent interest from the industry partners to extend the project. Another reviewer commented that several important findings have been reported, including effect of water, influence of ceria-supported catalyst, etc.

A reviewer said that sulfur pick-up and removal under various conditions showed a whole cycle of sulfur on the catalyst. The reviewer added that the optimal condition for removing sulfur with spectroscopy data helped optimize the catalyst operation condition.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer was not clear on what the technical deliverables are, but added that if there are technical results that can be applied, there is a clear path to apply to the Dodge Ram. The reviewer continued that the overall technical approach of designing active catalysts from scratch is a noble and high payoff objective, so good results will find their way to the market.

A reviewer stated that the technology was already transferred, but the durability of the LNT at end-of-life is to be determined. Another reviewer felt that it had sort of done already. Several reviewers felt that the CRADA partners would use the technology directly. One reviewer added that this was a very good relationship, a fact which had been mentioned to him by members of both organizations.

One reviewer felt that regular technical reviews help to keep progress on track. The reviewer added that understanding of degradation must be accompanied by cost-effective methods to prevent.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

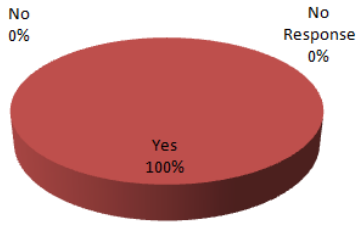
One reviewer said that it seems like a lot of work for $150,000. Another found the resources reasonable, considering the CRADA partner matching. One reviewer commented that the project comes to a close in 2008. Another reviewer wondered how much of the DOE funding goes for travel, publications and the like.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

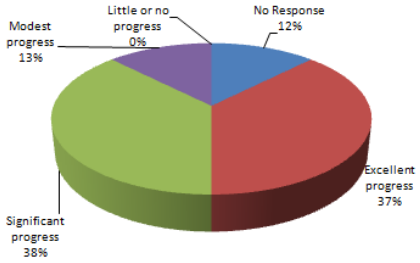
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Mechanism of Sulfur Poisoning of NOx Adsorber Materials (CRADA with Cummins)

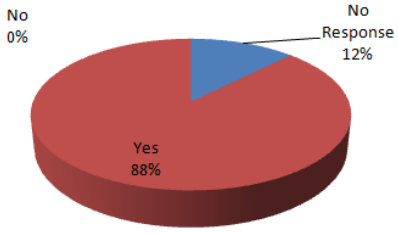
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



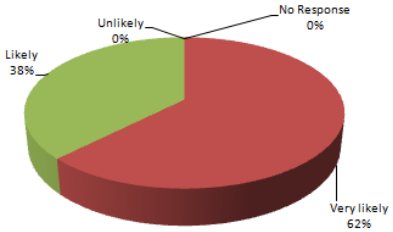
Question 3: Characterize the technical accomplishments and progress toward goals.



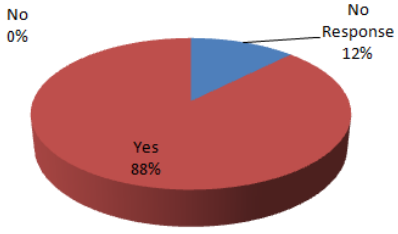
Question 2a: Are the goals of the project technically achievable?



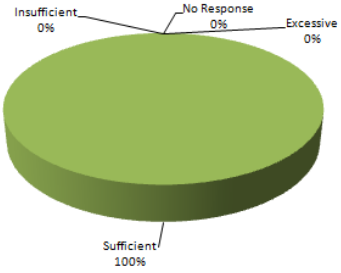
Question 4: How likely is the project team to move technologies into the marketplace?



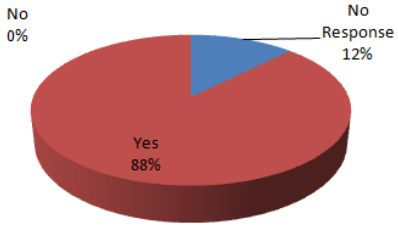
Question 2b: Have the technical barriers been identified and addressed?



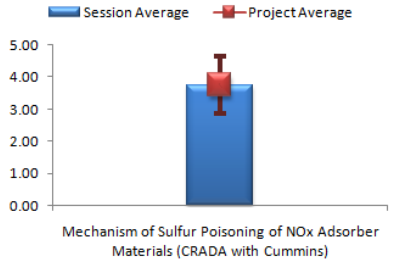
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



NOx Adsorber Fundamentals (Charles Peden, of Pacific Northwest National Laboratory)

Reviewer Sample Size
This project had a total of 10 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that any reduction in NOx emissions via active aftertreatment provides potential to break the traditional BSFC - NOx tradeoff. The reviewer adds the consortia based, non-competitive based approach moves the industry/academia forward in a collaborative way - the end result is better thermal efficiency.

Another reviewer states that the early NOx adsorber systems on the market are quite non-optimal and better understanding of this technology should lead to their improved fuel efficiency. One respondent believes that improving NOx storage capacity at high temperature greatly enhances GDI potential benefits to improve fuel economy. A reviewer states that diesels need NOx catalysts, and LNTs need significant improvement in cost and robustness. Another reviewer comments that LNT is one of the key technologies for Lean deNOx, which boosts fuel efficiency under lean burn condition for engines, while meeting gaseous emission standards.

A reviewer believed that higher efficiency and broader temperature range will increase the probability of petroleum use reduction when using NOx adsorbers. Another stated that this supports the introduction of the lighter diesel engines for transportation application.

One reviewer said that the project implemented high temperature studies based on the CLEERS survey, and assumes that improved BSFC is adequate to counter fuel usage penalty. Another reviewer says that like other CLEERS projects, this is a basic research program dealing with substrates and catalyst chemistry, and that like other CLEERS projects; it may be applicable to both diesel and direct-injection gasoline.

One reviewer found good connection between mechanism and model building.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer believes that with this being a consortium-based program, deployment is essentially automatic. The reviewer adds that the steering committee has a heavy industry focus including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer continues that DOE may want to consider having a similar consortia operating for other research and development programs to enable or accelerate deployment.

A reviewer states that this project plays a distinct role in the overall portfolio of NOx adsorber-related programs by providing insights into their underlying chemical mechanisms and surface science. Another reviewer comments that the project ties to CLEERS modeling studies; effects of CO_2 and water effects on NOx adsorption and storage, and the importance of chemical composition and phase where NOx adsorbs.

A reviewer comments that there should be work on improving precious metal utilization is critical for implementation of cost effective NOx aftertreatment system for large displacement engines as well as more work needed on aged catalysts. The adsorber adds that all LNTs look good green but the reviewer want to know how it works after an appropriate aging.

A reviewer comments that unknown areas of NOx adsorber performance have been identified and the technical approach is adequate for closing gaps. Another reviewer states that the research activity has contributed to Cummins' heavy duty truck application.

One reviewer states that PNNL has used some analyses to find useful insights with tools no one else has (i.e., high resolution NMR). Another reviewer comments that the program is using the appropriate techniques to get to their answer. One reviewer felt the work was not directly applicable but should be directionally OK.

A reviewer stated that this is a results project and does not carry the delivery risk. The reviewer stated that effective use the washcoat and precious metals is also of prime importance for cost. The reviewer went on to say that the learning will be useful in constructing real systems, and added that the layering of NOx storage was fascinating.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer states that CO_2 and H_2O impacts are quantified but was not sure how important the result is. The reviewer continues that the impact of the substrate, the impact to the overall kinetics is valuable and shows that the screening method should be applied more widely to screen substrate materials. The reviewer expressed concern that results are limited to degreened catalysts, when they really want to know the full thermal aged impact.

Another reviewer comments that the work identified phases of sulfur adsorbed on Alumina as "monolayer" and "bulk" phases which gave different performance characteristics for NOx adsorption. CO_2 affects bulk nitrate decomposition, mostly delay NO_2 release and reduce NO deabsorption.

One reviewer states that the insights on barium sites are very exciting, and depend on unique capabilities at PNNL. Work on PGM dispersion will be very important. Another reviewer states that the reported results elucidated several significant aspects of the NOx adsorber chemistry, for example offered possible explanation for the existing literature controversy regarding the impact of H_2O and CO_2 on catalyst performance due to different populations of Ba on the catalyst surface. The reviewer continues that the initial work on the high-T adsorber material also appears quite promising.

Another reviewer says that this was a good presentation of compositional changes and differences between bulk and monolayer sites - mechanism during regeneration, higher activity with magnesium aluminate vs. alumina as support for BaO and Pt allows better dispersion to avoid sintering of Pt.

A reviewer comments that $MgAl_2O_4$ support material and its dispersion characteristics are nice studies. The reviewer adds that the work identifies potential ways of having reduced precious metal loading, which can lead to broader use of NOx adsorbers. Another reviewer comments that the work is solid and it appears to be very original. This reviewer thinks the catalyst system designer can use this material.

One reviewer stated that hopefully a more rigorous treatment of the data will lead into more formal mechanistic modeling.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer states that the Cummins support is indicative of this tech transfer, the reviewer adds that nine technical publications over the last year are very impressive. Another reviewer comments that

the CRADA with Cummins with good acknowledgement from John Wall (VP/CTO at Cummins), the reviewer adds that upcoming work addresses likely combinations with DPF downstream, and that transfer depends on market for LNT's in light duty diesel applications. Two other reviewers commented on the close cooperation with industry via CLEERS and several CRADAs.

A reviewer felt that the work encouraged catalyst suppliers to reformulate their LNT catalysts with the new spinel alumina. Another reviewer commented that systematic study on alkaline earth doped alumina and gamma-alumina is highly useful to stabilized adsorber and platinum catalysts are highly valuable.

Another reviewer stated their belief that incremental improvements of efficiency and thermal operating range are likely to be used in commercial devices. One reviewer said that Toyota had revealed a parallel path and will apply it. A reviewer believed that some of the findings are already being used in the market transformation

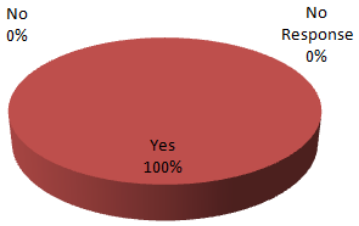
One reviewer stated that it would be very helpful to have all the CLEERS work highlight how all the labs work together. The reviewer believed it was not done well and was confusing. The reviewer believes it appears that there are competing groups and overlap of work, which is probably not the case. The reviewer mentions this here but it is a comment basically on all the CLEERS work. The reviewer believes this could be corrected with a summary slide and how all these are organized within this program and not repeat similar sounding programs.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
A reviewer questioned why this project received $400,000 compared to less funding for other projects. The reviewer wondered how much effort is expended on publications, presentations and travel. “Same comment applies for other projects throughout!” this reviewer commented. Another reviewer commented that while the project by itself is adequately funded, there are overlaps of technical activities at other NOx adsorber projects at other National Labs. One reviewer stated that as the program has continued for a few years, the program is approaching its close in next year.

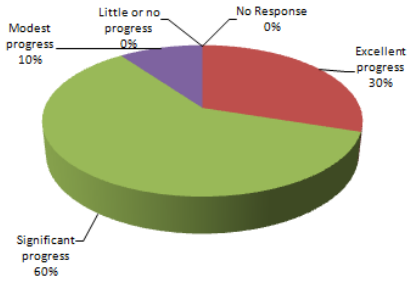
Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.
There were no expository comments for this question: refer to the graphic on the next page for this project’s summary score.

Project: NOx Adsorber Fundamentals

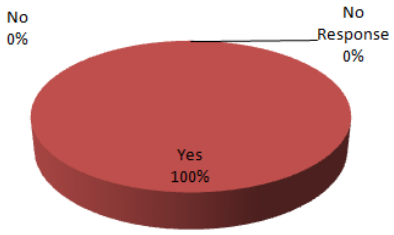
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



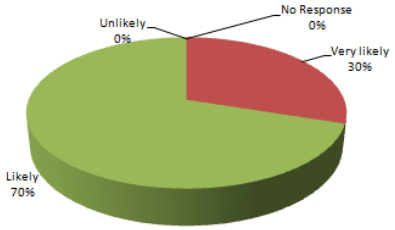
Question 3: Characterize the technical accomplishments and progress toward goals.



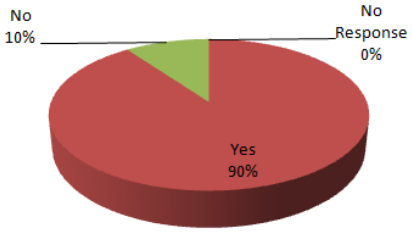
Question 2a: Are the goals of the project technically achievable?



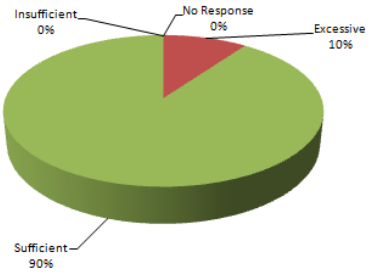
Question 4: How likely is the project team to move technologies into the marketplace?



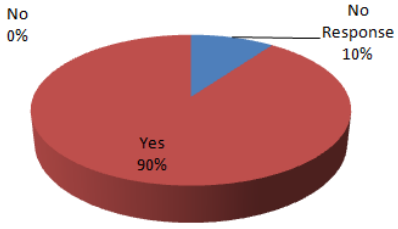
Question 2b: Have the technical barriers been identified and addressed?



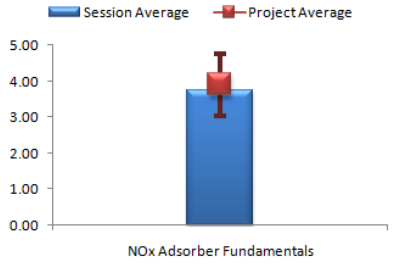
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



NOx Adsorber R&D (CRADA between ORNL and International Truck and Engine Company) (Todd Toops, of Oak Ridge National Laboratory)

Reviewer Sample Size
This project had a total of 10 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer felt that LNT development and understanding was okay, but that this is not a new topic. The reviewer felt that very general objectives were presented and that it was not a new topic. The reviewer was unsure why this CRADA was important or unique. The reviewer was also puzzled that no data was present, and felt that as a result no value was being communicated.

A reviewer stated that durability of LNT was a major issue to enable dieselization. The reviewer felt the goals were limited, but that this was in keeping with the project's low funding. The reviewer thought the project seemed to be just testing used catalysts on a bench reactor. The reviewer did not believe that this requires National Lab capabilities, and that vendors such as SWRI can do this kind of testing, and all catalyst suppliers have the capability. The reviewer wondered what is ORNL adding.

A reviewer commented that while there was are no clear novel results that can come out of LNT portion of the research, the planned refocusing on SCR will provide opportunity for higher efficiency of future diesel engines, thereby reducing fuel use.

A reviewer said that at low temperature, CO and hydrocarbons tend to limit the NOx conversion due to competitive adsorption, and that the project addresses the fundamental of reaction kinetics and optimize vehicle operation conditions to optimize system efficiency.

Another reviewer stated that the VT mission can't be dealt with without addressing emissions control. The reviewer added that emissions have an associated energy penalty. The reviewer felt that technology deployment aspects are in focus as the CRADA participant is close to the front line.

A reviewer felt that work on field aged catalysts is important. Another reviewer saw good collaboration with International Truck with goals to increase NOx conversion during low temperature operations. A reviewer stated the project was in line with the DOE mission.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer felt the project had vague goals and needed to be more specific. The reviewer strongly suggests that DOE adopts quantitative goals, and also for intermediate goals. The reviewer felt that no specific barriers had been clarified and that no data was provided. Another reviewer felt that this was mostly measurement-based results.

A reviewer commented that there was good catalyst diagnostics work, but perhaps this was not the best use of the National Lab capabilities and expertise. One reviewer said that this is a small project, so the objectives need to be fairly modest. The reviewer continued that the generic results (relative low temperature activity of CO vs. C_3H_6) are already well known; new information is presumably the results for specific, aged catalysts.

Another reviewer was glad that the project was looking at some real industry barriers, aging and the subsequent low temperature LNT operation. One reviewer felt the project addressed higher NOx

conversion and/or fuel economy; and developed a deep/fundamental understanding of emission control chemicals over a wide range of conditions; cost effective solutions sought. The reviewer added that aging protocols jointly developed to represent engine conditions.

One reviewer felt that data generated in this CRADA with International should be helpful. It appears to fall in line with expected performance.

One reviewer felt the project addressed real-life issues and a project development hurdle. The reviewer added that the program capitalizes on NTRC core competency to help an industrial partner. The reviewer also felt that the program capitalizes on an excellent bridging of fundamental/basic research to real-life applications.

A reviewer wondered why the project would refocus on SCR, suggesting instead the project press on to ITEC to consider a 4-way catalyst approach. Another reviewer felt the planned refocusing on SCR should enable overcoming the barriers associated with LNT.

A reviewer stated that the project has systematically studied space velocity and temperature impact on NOx conversion with two reductants (i.e., CO and C_3H_6) on two different catalysts. It was observed that CO is a much more effective reductant than C_3H_6. NH_3 and N_2O were observed as reaction intermediates released to exhaust gas stream during the regeneration. However, the project needs to address the reaction mechanism when the data becomes available, coupled with surface spectroscopy to identify the regeneration pathways. It is also highly desirable to study the catalyst regeneration in the presence of sulfur. Hopefully the next program will address these issues.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer stated that there was no data provided, and that trends are not valuable. The reviewer added that without data it was hard to see any technical results or accomplishments. The reviewer saw no confidential concerns, and wondered why data were not shown. Another reviewer wondered why ITEC didn't have a supplier do the work, and stated a belief that this type of work was happening at Oak Ridge about four years ago. One reviewer felt the results so far of the LNT work are not new. The reviewer continued that some results may be useful to the CRADA industrial partner (ITEC) due to the evaluation of ITEC specific devices and data points, but would be more appropriate for the User Agreement (Work for Others) as opposed to CRADA. A reviewer found the work relevant, and the project connected with the stake holders. Another reviewer felt the results are compatible with the funding. Another reviewer said that the project evaluated two engine-aged catalysts, identified chemical processes limiting LNT performance, identified by-product variants vs. temperature; quantified reductant effect. One reviewer stated that CO and C_3H_6 are important model reductant in exhaust for learn catalyst performance. The details of reaction pathway with these two different reductants will be highly desirable for better understanding and design new catalysts.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer asked "What technology?" The reviewer continued to state that LNT is a commercial technology today in the USA, and wondered what was shown in the presentation that could not be demonstrated with a commercially-available Dodge Ram system. A number of reviewers cited direct involvement of ITEC, along with ITEC's technical direction should ensure transfer of useful results to the marketplace. One reviewer expressed concern about the switch to SCR. Another thought this move was a good idea.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

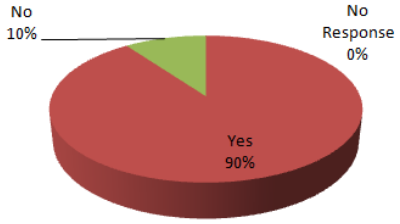
One reviewer felt there had been low return on investment because no value had been shown by the work. Another felt that it was meager funding to make a difference. Another reviewer felt the project would be more appropriately funded by an industrial partner. One reviewer saw the resources as limited due to a lack of a non-disclosure agreement with a catalyst supplier in order to understand molecular implications. Another reviewer listed work on fundamental understanding the regeneration process with various reductants and co-existence of the reductants will need additional resources on surface species and reaction mechanisms.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

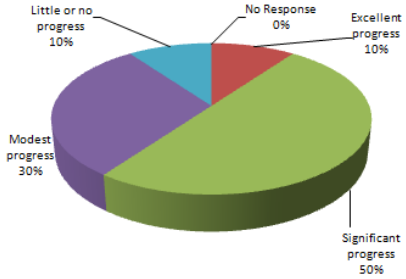
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: NOx Adsorber R&D (CRADA between ORNL and International Truck and Engine Company)

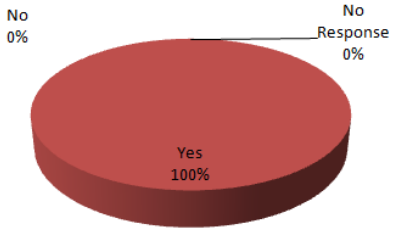
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



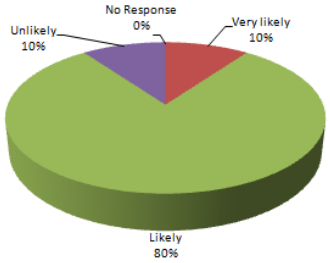
Question 3: Characterize the technical accomplishments and progress toward goals.



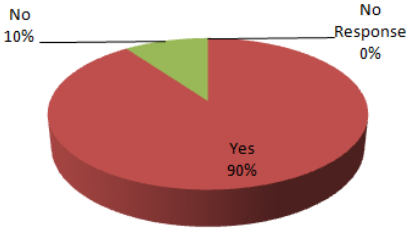
Question 2a: Are the goals of the project technically achievable?



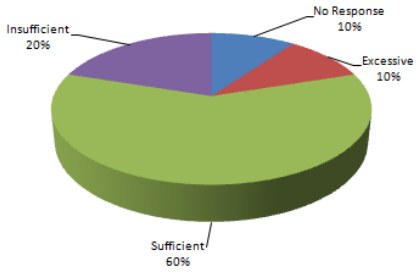
Question 4: How likely is the project team to move technologies into the marketplace?



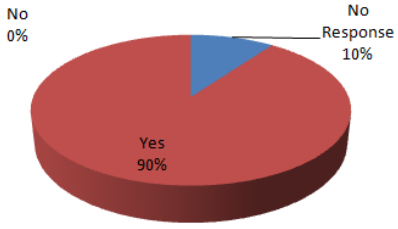
Question 2b: Have the technical barriers been identified and addressed?



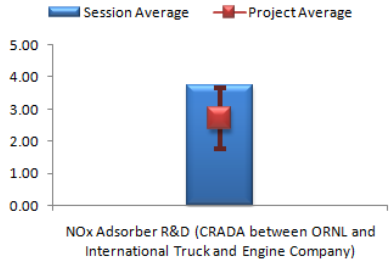
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



NOx Aftertreatment CRADA with Cummins (Bill Partridge, of Oak Ridge National Laboratory)

Reviewer Sample Size
This project had a total of 8 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer says that supporting the adoption of diesel for the LDT market seems very practical, yet the objectives fully utilize national labs skill sets. The reviewer continues that the online oil dilution method looks very good, and comments that there was nice tool development by Oak Ridge National Lab. The reviewer continues that SpaciMS is another good application of a national lab tool that is applied to real world issues that are difficult for OEMs to handle; the reviewer adds that NH_3 is tricky.

A reviewer suggests getting the real-time feedback on oil dilution to investigate engine operations and novel engine hardware solutions to avoid high oil dilution. A reviewer states that on-engine real time measurement systems can diagnose engine oil dilution issues on time; the reviewer adds that the system can impact fuel injection for LNT regeneration. One reviewer says that better understanding of diesel LNT has potential of reducing diesel fuel use.

Another reviewer comments that the project focused on fuel efficient diesel engines driven by Cummins market penetration drivers. The reviewer wondered what the actual improvements in BSFC were. Another reviewer says that diesel NOx control is needed. Oil dilution is a major limiter for several technologies. NH_3 generation and use is increasingly part of aftertreatment systems.

A reviewer saw evidence of a good connection with industry to understand key issues. Another reviewer stated that the VT mission can't be dealt with, without addressing emission control. The reviewer adds that emissions have an associated energy penalty and continues that technology connection with industry to understand key issues.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer comments that supporting adopting diesel for the LDT market seems very practical, yet the objectives fully utilize national lab skill sets. The reviewer continues that interaction with CLEERS is a good plus - increases collaboration. Another reviewer states the project addresses a real-life issue and a product development hurdle, the reviewer continues that the project capitalizes on an NTRC core competency to help a major industrial partner.

It is stated by a reviewer that the project be combined with a commercially available oil condition monitor, and develop an on-board fuel dilution sensor and also to study the phenomena and trend of fuel depletion from the crankcase oil under realistic operation conditions. This can be a nucleus for a future project.

A reviewer said that an oil dilution measurement system has been successfully developed. Another reviewer suggested that previously developed MS sampling will add to the understanding of ammonia generation and control.

A reviewer suggests that the project should use the SpaciMS much more to determine the chemistry along the core length for different types of LNT formulations and after aging these formulations. The reviewer continues that some of these activities are in the projects future plan, but encourages aggressively pursuing this plan and including the LNT/SCR system and the NH_3-SCR only concept.

Another reviewer focuses on a real-time on-engine diagnostic oil dilution to streamline development process; very sophisticated tool to provide accurate and timely feedback to the engine test engineers. The reviewer continues ASTM GC correlation to LIF. Technical targets established for oil dilution rate. The reviewer adds that this was a well-structured approach.

One reviewer states that the future plans seem to involve an expansion of objectives (cyclic dispersion). The reviewer warns against "mission creep" so objectives don't move beyond funding.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.

A reviewer comments that they have developed a robust tool for real-time oil dilution rate. The reviewer adds that understanding of LNT ammonia chemistry for managing slip and system design provides valuable input to models. Another reviewer comments on a new approach to identify real time fuel dilution. The reviewer calls this clever, and suggests patenting it and pursuing further refinements. The reviewer wonders how the project capitalizes on NH_3 generation, but does not address NH_3 slip. The reviewer also says to be aware of the cross talk and interference of other species when measuring NH_3, that is, know/ensure what you're measuring. The reviewer wished to know is the statistically significant, or is it once (a few) through measurement?

A reviewer believes that a useful oil dilution measurement technique was developed, and that the continued LNT study was also learning new things. Another reviewer added that SpaciMS was developed. Another reviewer focused on how the measurement system probes the catalyst chemistry to elucidate reaction mechanism, adding that the information helps design catalyst and engine operations.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer commented that there were good objectives for a national lab, with good results and efforts. The reviewer also felt that this was the appropriate partner to put the results into the market. Numerous other reviewers comment that the methodology developed here was already being used by the CRADA partner. One reviewer wondered if the oil dilution instrumentation could be commercialized. Others saw a strong partnership with Cummins leading to continued success of reaching goals. One reviewer believed that Cummins will be able to use this real time diagnostic to better control fuel dilution of lube oil.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

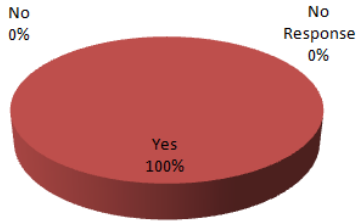
A reviewer stated that the next steps look good, especially the oil dilution diagnostic as applied to cylinder and cyclic dispersion. Another reviewer said that SpaciMS is great and wondered if there was a SpaciFTIR. The reviewer felt that would be great to study NH_3 SCR catalysts. A reviewer wondered if the development of an on-board oil dilution sensor makes sense. Another reviewer warned against growing the team/facilities too fast. One reviewer felt there had been a very efficient use of resources. A reviewer felt that the funding was excessive.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

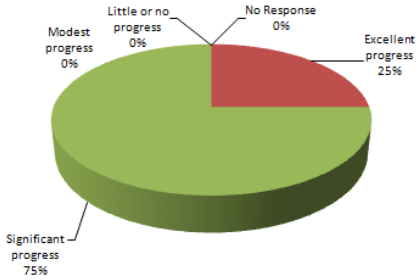
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: NOx Aftertreatment CRADA with Cummins

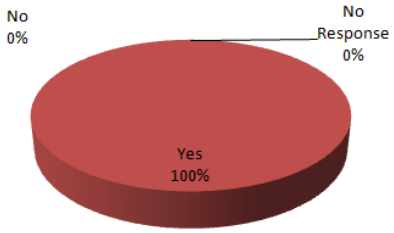
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



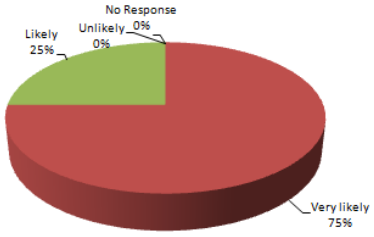
Question 3: Characterize the technical accomplishments and progress toward goals.



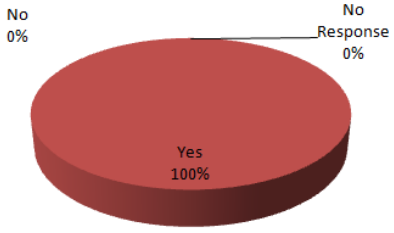
Question 2a: Are the goals of the project technically achievable?



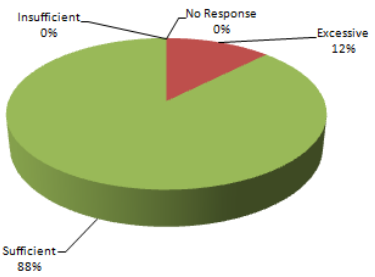
Question 4: How likely is the project team to move technologies into the marketplace?



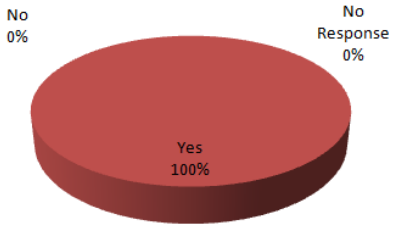
Question 2b: Have the technical barriers been identified and addressed?



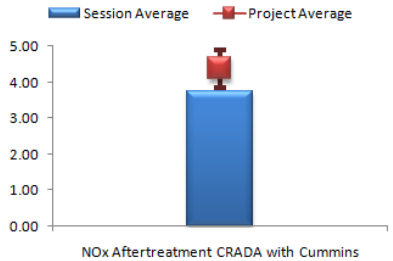
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



PNNL CLEERS Activities – Overview (Darrell Herling, of Pacific Northwest National Laboratory)

Reviewer Sample Size
This project had a total of 8 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that any reduction in NOx emissions via active aftertreatment provides potential to break the traditional BSFC - NOx tradeoff. The reviewer adds the consortia based, non-competitive based approach moves the industry/academia forward in a collaborative way - the end result is better thermal efficiency. Another reviewer felt that the program was valuable for coordination, adding that various companies cannot communicate easily and that CLEERS creates a forum where communication can occur. A second reviewer also felt that it is important to keep interacting with all cross sections of the emission industry.

One reviewer saw clear ties to industrial needs in "Performance Measures" slides. Another commented on a good link of aftertreatment and the commercial feasibility of diesel engines in the future. Another reviewer commented that the systematic study of DPF, SCR and LNT systems will provide critical information for the industry to get fully understanding on various systems.

A reviewer said that more projects and activities need to be realigned to include more SCR research. Another viewer said that VT goals cannot be achieved without addressing emissions control. Emissions control has an associated energy penalty.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer believes that this being a consortium based program, deployment is essentially automatic. The reviewer adds that the steering committee has a heavy industry focus including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer continues that DOE may want to consider having a similar consortia operating for other research and development programs to enable or accelerate deployment. A reviewer commented that this was a report-out of results. Another reviewer stated that this is a continuous crosscut activity, and that some of the question elements are not applicable to the project. One reviewer did not see why the results were anything but straightforward. One reviewer commented on the good recognition of ties between basic fundamentals and industrial systems; micro modeling tools that are user-friendly (GUI).

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
A reviewer stated that in general the CLEERS activities do not have quantitative targets - so the targets are achievable since the strategy tends to be general/directional and not quantitative. The reviewer went on to say that CLEERS is more focused on methodologies and deployment or these, rather than on specifically overcoming the identified technical barriers. The reviewer adds deployment aspects of coordinating National Lab and academia towards industry needs will continue to pay increasingly significant dividends over time (in my opinion). The reviewer thinks this approach deserves a spot in the DOE strategy.

Another reviewer commented that simulation is an extremely robust and useful tool when used properly. One reviewer commented that they had seen similar data from suppliers that were a few years old.

Another reviewer mentioned coordination of unified programs including DPF, SCR and LNT and future 4-way system.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer states that this being a consortium based program, deployment is essentially automatic on all levels (from what we learn of the hardware, to the diagnostic methods, to the cross-fertilization of the different technical discussions, to other insights into the underlying physics). The reviewer adds that the steering committee has a heavy industry focus - including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer suggests that DOE may want to consider having a similar consortia operating for other RD programs to enable or accelerate deployment. The reviewer felt that CLEERS is not really developing specific aftertreatment technologies that would apply to an engine, rather it is using standard commercially available catalysts to develop better understanding and methodologies, in DOE's diverse portfolio, and that this is an excellent program. The reviewer suggests that more opportunities for this approach should be applied to other programs if possible to further enhance deployment.

A reviewer mentions that deployment aspects are in focus as CLEERS participants are close to the front line in their respective industries.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

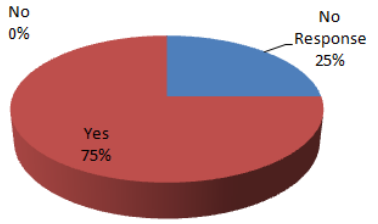
A reviewer believes the CLEERS return on investment is very good due to the collaborative approach and the focus on methodologies and base understanding over developing new hardware. Another reviewer makes a general comment that applies to the funding and projects carried out by the National Laboratories. There seems to be a tendency to duplicate facilities at more than one site. For example, a review of the last several years (10 years?) investments in engine and chassis dynamometer installations at various National Laboratories could be revealing. A general comment was also made that investing in technology and enhanced collaboration among the National Laboratories is a far better utilization of DOE funds than spending it on brick and mortar. Even if a national lab is using non-DOE funding for facility duplication, DOE should evaluate such as a poor investment. The reviewer goes on to ask if there is a rationale for review of the CLEERS charter since the focus now on more deployment rather than basic research.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

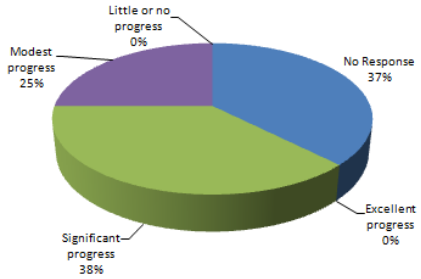
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: PNNL CLEERS Activities – Overview

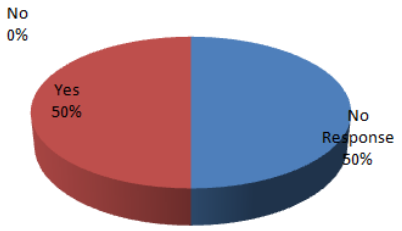
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



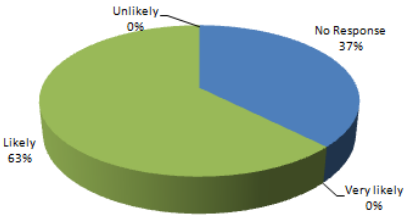
Question 3: Characterize the technical accomplishments and progress toward goals.



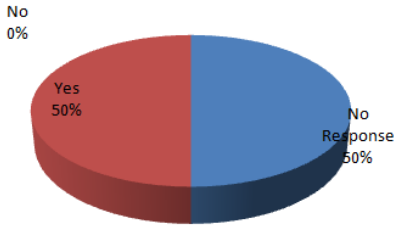
Question 2a: Are the goals of the project technically achievable?



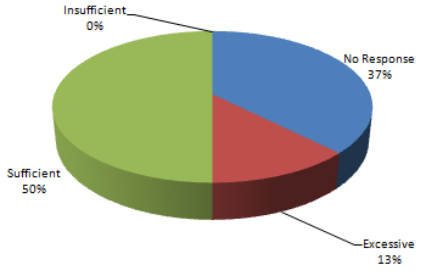
Question 4: How likely is the project team to move technologies into the marketplace?



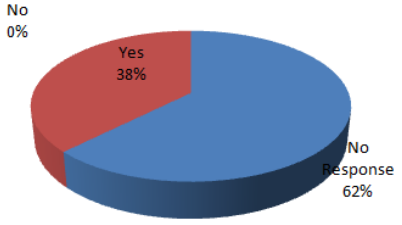
Question 2b: Have the technical barriers been identified and addressed?



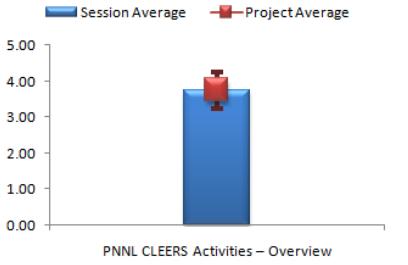
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Pre-Competitive R&D on NOx Adsorber Mechanisms (Jae-Soon Choi, of Oak Ridge National Laboratory)

Reviewer Sample Size
This project had a total of 7 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that any reduction in NOx emissions via active aftertreatment provides potential to break the traditional BSFC - NOx tradeoff. The reviewer adds the consortia based, non-competitive based approach moves the industry/academia forward in a collaborative way - the end result is better thermal efficiency. Another reviewer felt that the program was valuable for coordination, adding that various companies cannot communicate easily and that CLEERS creates a forum where communication can occur. A second reviewer also felt that it is important to keep interacting with all cross sections of the emission industry.

Another reviewer commented that deeper understanding of NOx adsorber mechanisms and resolving sulfation issue could enable lean-burn gasoline engines, which will reduce petroleum use in transportation. A reviewer commented that NSR catalysts are a vital part of diesel operation. The reviewer hoped this could be transferred. A reviewer also said that the fundamental understanding of sulfaltion and desulfation are critical for commercial success of LNT, as well as further improvements on catalyst and substrate.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer commented that with the state-of-the art tools and approaches used by ORNL, it is likely to expect that the chemistry and physics of NOx adsorbers will be fully understood through this research. Another reviewer suggested that the program be bridged to some possible application concepts at NTRC-ORNL. One reviewer said that while confidentiality is always a barrier, CLEERS has done a good job balancing this.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
A reviewer stated that CLEERS is more focused on methodologies and deployment or these, rather than on specifically overcoming the identified technical barriers. The reviewer adds deployment aspects of coordinating National Lab and academia towards industry needs will continue to pay increasingly significant dividends over time. The reviewer thinks this approach deserves a spot in DOE strategy.

A reviewer commented that they were always interested in real world fouling factors, like soot, ash etc., and dosing formulation and distribution issues. Another reviewer stated that conceptual LNT model already created. There are all reasons to believe that with the current level of effort and leveraging National Labs' capabilities, deeper understanding of NOx adsorber mechanisms should be achievable.

One reviewer suggested that it was much easier to make devices work in the powder lab than in an exhaust pipe.

Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.

A reviewer states that with this being a consortium-based program, deployment is essentially automatic on all levels (from what we learn of the hardware, to the diagnostic methods, to the cross-fertilization of the different technical discussions, to other insights into the underlying physics). The reviewer adds that the steering committee has a heavy industry focus - including both light-duty and heavy-duty and that this is a good model for deployment. The reviewer suggests that DOE may want to consider having a similar consortia operating for other R&D programs to enable or accelerate deployment. The reviewer felt that CLEERS is not really developing specific aftertreatment technologies that would apply to an engine, rather it is using standard commercially available catalysts to develop better understanding and methodologies, in DOE's diverse portfolio, and that this is an excellent program. The reviewer suggests that more opportunities for this approach should be applied to other programs if possible to further enhance deployment.

Another reviewer stated that working on commercial catalysts made the understanding more close to the real world application as well as providing opportunity to improve catalyst formulations.

A reviewer felt there could be enhancement if a specific industrial entity "owned" the project rather than the pool involved in CLEERS. The reviewer added that since it is precompetitive, there is a likelihood of a follow-up program to apply and transfer the technology.

Another reviewer felt that while deeper understanding of the NOx adsorber mechanisms is achievable, resolving sulfation issues is less likely, making their broad introduction to the marketplace questionable. One reviewer wondered what the robustness issues were.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?

A reviewer wondered why DOE is sponsoring this project at ORNL, competitively awarded. The reviewer also wondered if there was a rationale for review of the CLEERS charter and funding level since the focus now is on more deployment rather than basic research.

A reviewer stated that funding of $100,000 seems sufficient for this research, commensurate with the low likelihood of the broad deployment of this technology. Another reviewer stated that this is the most difficult area in new diesels, and we are only putting one FTE on the project.

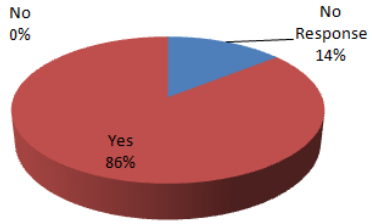
A reviewer believes the CLEERS ROI is very good due to the collaborative approach and the focus on methodologies and base understanding over developing new hardware.

Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

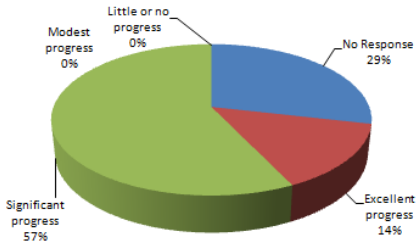
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Pre-Competitive R&D on NOx Adsorber Mechanisms

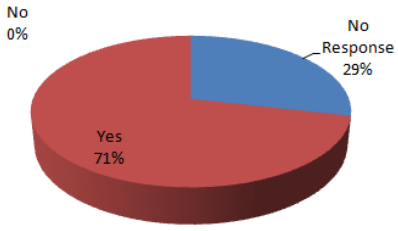
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



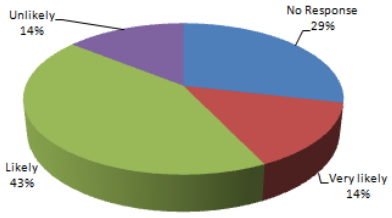
Question 3: Characterize the technical accomplishments and progress toward goals.



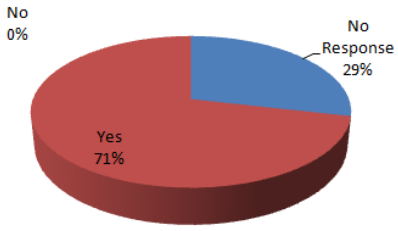
Question 2a: Are the goals of the project technically achievable?



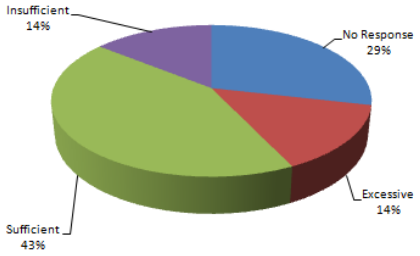
Question 4: How likely is the project team to move technologies into the marketplace?



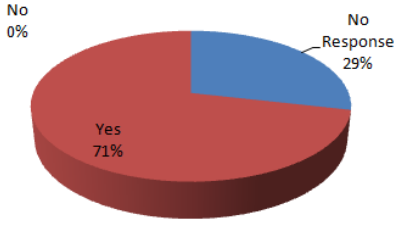
Question 2b: Have the technical barriers been identified and addressed?



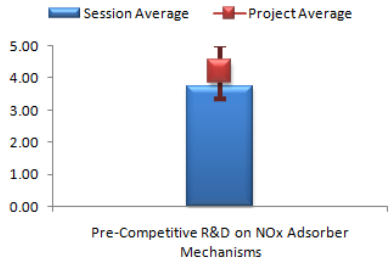
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating



Urea SCR Fundamentals (Jonathan Male, of Pacific Northwest National Laboratory)

Reviewer Sample Size
This project had a total of 2 reviewers.

Question 1: Does this activity support the overall DOE objectives of petroleum displacement? Why or why not?
A reviewer stated that it addresses optimized urea usage and fuel economy; integration of emissions control systems. Another reviewer believes that the implementation of the SCR aftertreatment system is expected to lead to improved fuel efficiency.

Question 2: Are the goals of the project technically achievable? Have the technical barriers been identified and addressed? Is the project likely to overcome those technical barriers? Please comment on the project's strategy for deployment of technologies.
A reviewer cites the developing understanding of competing reactions; the study of thermal transients for optimized conversion efficiencies and component integration; and the examination of alternative reductants to ammonia. Another reviewer mentioned the focus on the transient SCR behavior is well aligned with one of the key challenges of the SCR technology.

Question 3: Characterize your understanding of the technical accomplishments and progress toward DOE goals: please state the reasons for your assessment.
A reviewer describes the demonstration as having a good understanding of the reactant interactions for efficient urea usage, as well as transient effects. The reviewer adds the method developed for testing small powder samples ensures faster turnaround of results - need to continue verifying with monolith samples. Another reviewer states that the initial experimental work is interesting, but so far appears mostly phenomenological (which is understandable at this early stage of the SCR project). The reviewer says that going forward it would be more appropriate for the National Lab to focus on understanding the underlying chemical and reaction engineering processes rather than detailed replication of the FTP or any other transient cycles.

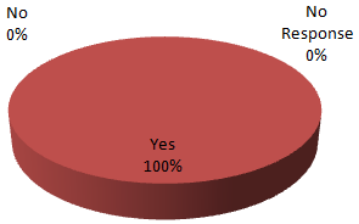
Question 4: What is the likelihood that the project team will move the technologies toward or into the marketplace? Please state the reasons for your selection.
A reviewer describes the project as a very well-aligned fundamental study with the overcoming of real-world barriers. Another reviewer states that close ties to industry are ensured by CLEERS format.

Question 5: How sufficient are the resources for the project to achieve the stated milestones in a timely fashion?
Both reviewers were unsure.

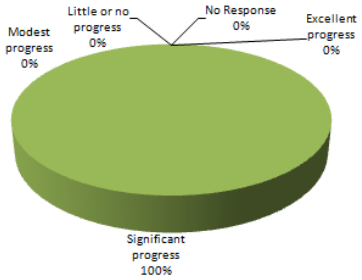
Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.
There were no expository comments for this question: refer to the graphic on the next page for this project's summary score.

Project: Urea SCR Fundamentals

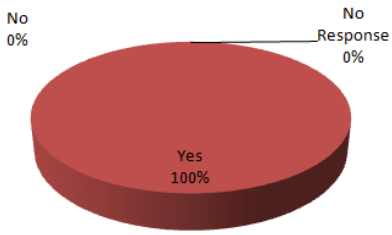
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



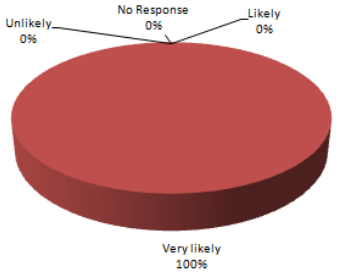
Question 3: Characterize the technical accomplishments and progress toward goals.



Question 2a: Are the goals of the project technically achievable?



Question 4: How likely is the project team to move technologies into the marketplace?



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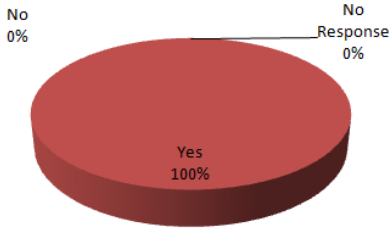
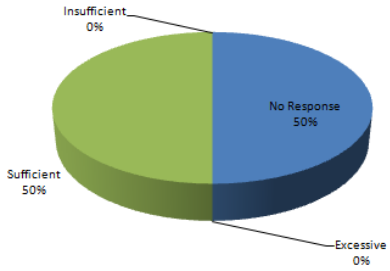
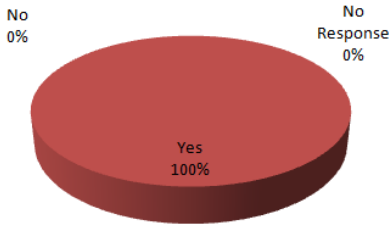


Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



Question 2c: Is the proposed work likely to overcome technical barriers?



Question 6: Overall Rating