

13. Health Impacts

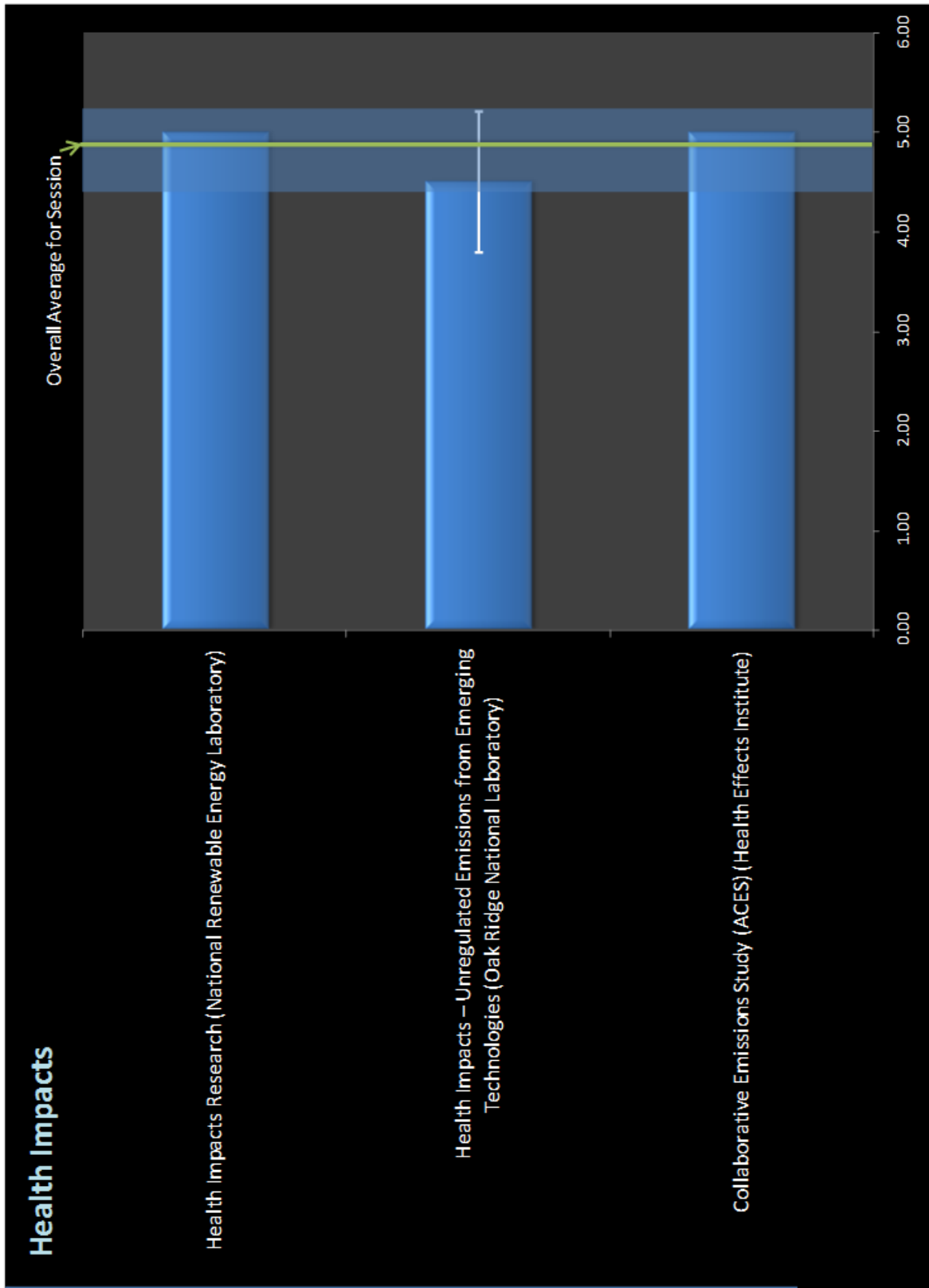
Introduction

The Health Impacts work is being conducted to identify that any potential health hazards associated with the use of new vehicle technologies being developed by VT will not have adverse impacts on human health through exposure to toxic particles, gases, and other compounds generated by these new technologies.

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
13-3	Collaborative Emissions Study (ACES) (Dan Greenbaum, Health Effects Institute)	5.00	0.00
13-6	Health Impacts – Unregulated Emissions from Emerging Technologies (John Storey, Oak Ridge National Laboratory)	4.50	0.71
13-9	Health Impacts Research (Doug Lawson, National Renewable Energy Laboratory)	5.00	0.00
Overall Session Average and Standard Deviation		4.83	0.41





Collaborative Emissions Study (ACES) (Dan Greenbaum of Health Effects Institute)**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?

One reviewer wrote that this program will provide the scientific basis for arguing that the health risk of new technology diesel exhaust is much lower than traditional diesel exhaust. It will also provide important data to compare this new technology with gasoline and other combustion technologies used to power vehicles.

Another person stated that diesel engines present the potential for improved mileage and thus a possibility for reduced petroleum consumption. He goes on to state that health concerns are a critical factor in the use of diesel engines: EPA has set new restrictions on NO_x and exhaust particulate matter emissions; at the same time, scientific research has identified possible exacerbated health hazards associated with ultrafine or nanoparticulate exposures. Diesel exhaust particulate is ultrafine in size. It sometimes contains particulate or semi-volatile genotoxicants or other toxic materials, including some traces of metals. While new technologies are being tested by DOE and manufacturers that can control NO_x and PM emissions by weight, it is not fully known how the new engines or new control technologies will affect other characteristics of the engine particulate emissions, e.g., increasing numbers of emitted particles, or producing different size distributions or compositions or surface properties of final PM emissions. Such new properties of PM associated with new engine and/or control technologies, and new modes of operation, e.g., regeneration, should be evaluated as thoroughly and as early as possible given the possible subsequent rapid and massive public deployment of these technologies. This is a statement appropriate in general to all the DOE-VT Health Impacts research projects, including this HEI – ACES study.

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.

The first respondent stated that this project is one of a set of health impacts studies that are being performed by DOE-VT to better define and address the possibility of new health concerns that might be associated with new engines and control technologies. It is prudent for DOE to undertake these studies to evaluate and guide engine and control technology R&D from the earliest stage. This is a statement appropriate in general to all the DOE-VT Health Impacts research projects, including this HEI – ACES study.

The other person noted that this project has had lots of input from scientists from academia, regulatory agencies, and government. He adds that the plan is sound, and there has been significant progress in characterizing the emissions from four heavy-duty vehicles. The next phase, testing in a chronic bioassay, is on target to begin early in 2009.

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

One reviewer commented that there were many technical barriers that needed to be overcome. Fortunately, he adds, there are many experts on HEI research committees from academia, as well as from government and industry, who have assisted in overcoming these potential barriers. This expertise will continue to allow the project to move forward as challenges arise during the testing. Similarly, the other person noted that the HEI-ACES study is a major collaborative effort between



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well-established research institutes versed in the tasks of engine system selection, physical characterization of emissions, and animal model short- and long-term bioassay of engine emissions. These ACES chronic studies are important to see if there are unanticipated major health effects associated with these new engine/control technologies under some representative operating conditions.

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.

The first respondent indicated that many new techniques for measuring engine emissions, as well as biological endpoints in the animal studies, are being developed as part of this project. These will be transferred to other laboratories as the methodologies and results are reported and published in the peer-reviewed literature. In a fuller response, the other reviewer stated that there has existed for decades some contention on the general topic of chronic animal model studies of diesel exhaust. IARC, EPA, and NIOSH reviews of human and animal model data have concluded in general that diesel exhaust exposures possibly or probably pose a carcinogenic risk to man; but interpretation of past animal model studies has been varied, sometimes suggesting response only in non-representative overload conditions of exposure and epi-genetic bases for the induction of tumors in the experiments. Genotoxicant content of diesel exhaust is known to be a function of engine operating condition (load, speed), engine tune, and fuel. These cannot all be examined in chronic exposure studies. The short-term animal model studies planned can to some extent address these. While no in vitro studies are planned, it might be reasonable to collect and provide or archive exhaust materials for such assays, e.g., to isolate steady state or individual cycle component running conditions to identify possible modes of operation or sources of biologically active materials in the exhaust toward interpretation of animal model results or extrapolation to other engine design or operational factors.

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

The lone respondent stated that more funding would move the project along more quickly, but the funding is sufficient for now.

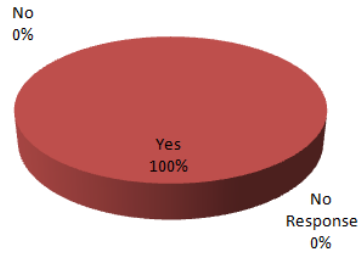
Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

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

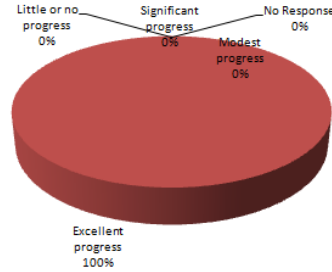


Project: Collaborative Emissions Study (ACES)

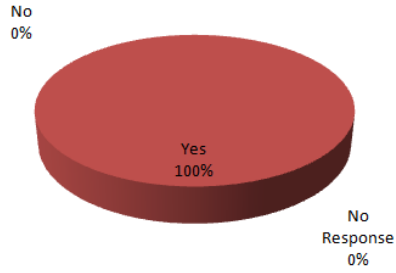
Question 1: Does this project support the overall DOE objectives of petroleum displacement?



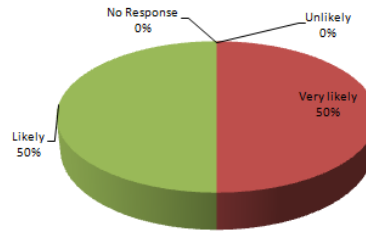
Question 3: Characterize the technical accomplishments and progress toward goals.



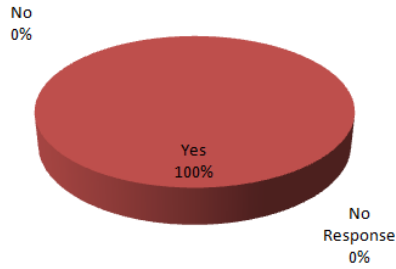
Question 2a: Are the goals of the project technically achievable?



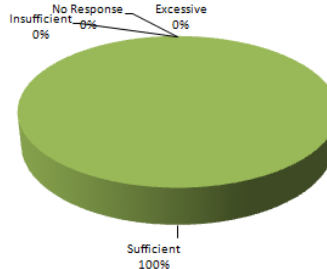
Question 4: How likely is the project team to move technologies into the marketplace?



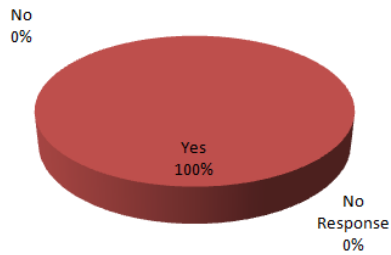
Question 2b: Have the technical barriers been identified and addressed?



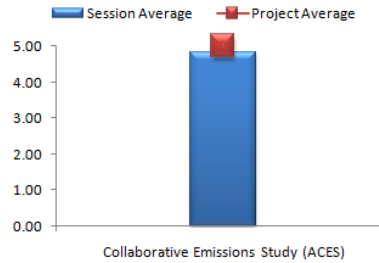
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



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



Question 6: Overall Rating



Health Impacts – Unregulated Emissions from Emerging Technologies (John Storey of Oak Ridge 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?

One person stated that this activity certainly has the potential of supporting DOE objectives, but it may not meet the objectives as it is currently being conducted. The reviewer is specifically concerned that testing is being conducted only using an engine dynamometer. He adds that measurement of emissions using this methodology can be quite different from those coming from a chassis dynamometer or from a vehicle tested on-road. He is concerned that the results from the engine dyno will not be compared to those from the other two methodologies. Thus the results being generated may have limited application to real-world emissions when these alternate technologies are being used in actual applications.

Another reviewer commented that diesel engines present the potential for improved mileage and thus a possibility for reduced petroleum consumption. He adds that health concerns are a critical factor in the use of diesel engines: EPA has set new restrictions on NO_x and exhaust particulate matter emissions; at the same time, scientific research has identified possible exacerbated health hazards associated with ultrafine or nanoparticulate exposures. Diesel exhaust particulate is ultrafine in size. It sometimes contains particulate or semi-volatile genotoxicants or other toxic materials, including some traces of metals. While new technologies are being tested by DOE and manufacturers that can control NO_x and PM emissions by weight, it is not fully known how the new engines or new control technologies will affect other characteristics of the engine particulate emissions, e.g., increasing numbers of emitted particles, or producing different size distributions or compositions or surface properties of final PM emissions. Such new properties of PM associated with new engine and/or control technologies, and new modes of operation, e.g., regeneration, should be evaluated as thoroughly and as early as possible given the possible subsequent rapid and massive public deployment of these technologies. This is a statement appropriate in general to all the DOE-VT Health Impacts research projects, including this Oak Ridge National Lab study.

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.

The first reviewer stated that one technical barrier of using an engine dynamometer is the problem with extrapolating the results to real world conditions. Another person noted that this project is one of a set of health-impacts studies that are being performed by DOE-VT to better define and address the possibility of new health concerns that might be associated with new engines and control technologies. He adds that it is prudent for DOE to undertake these studies to evaluate and guide engine and control technology R&D from the earliest stages, again noting that this is a statement appropriate in general to all the DOE-VT Health Impacts research projects, including this Oak Ridge National Lab study.

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

One person indicated that the ORNL study is very strong in characterization of MSAT volatile and semi-volatile organics. For PM, the respondent adds, particle size distributions are measured, but it



was not clear what analyses of POM are made. A difficult but possibly important factor in potential health effects might be composition with particle size, e.g., are metals found principally in the smallest ultrafine size range? Are PAH or some known genotoxicants found principally in some specific size ranges?

The other respondent stated that one of the most important new technologies for the future is SCR with diesel. This technology is already being used in Europe and many companies plan to employ this technology in the US starting in 2010. Dr. Storey presented no results on this technology.

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.

One reviewer noted that this group does not generally publish their results in the peer-reviewed literature, and thus the new techniques being developed will be very slow to reach the general research community, if at all. Similarly, the other respondent stated that peer-reviewed journals or an SAE Technical Paper might be important complements to DEER presentations for dissemination of these important research results, providing more detail data exposition and discussion, and to a wider audience.

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

The lone respondent stated that he thinks some of the funds being allocated to this project should be transferred to Dr. Doug Lawson's project, which is much more relevant and has made much more progress over the years.

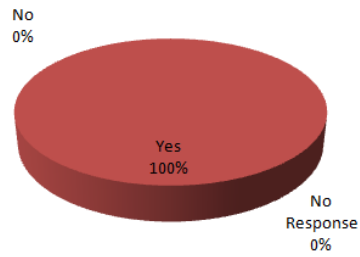
Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

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

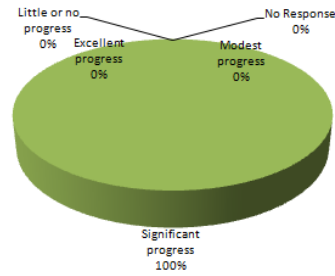


Project: Health Impacts – Unregulated Emissions from Emerging Technologies

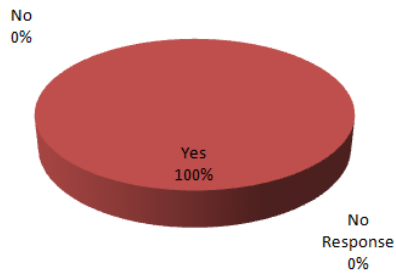
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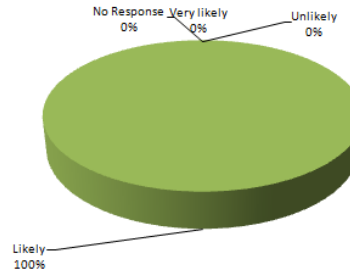
Question 3: Characterize the technical accomplishments and progress toward goals.



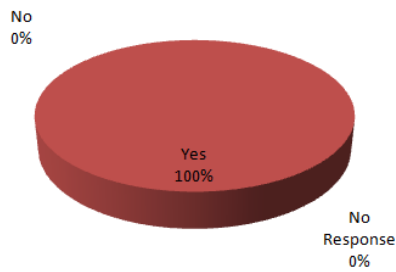
Question 2a: Are the goals of the project technically achievable?



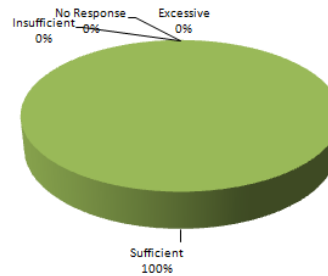
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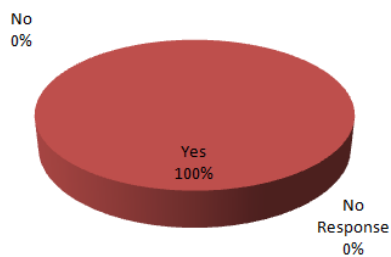
Question 2b: Have the technical barriers been identified and addressed?



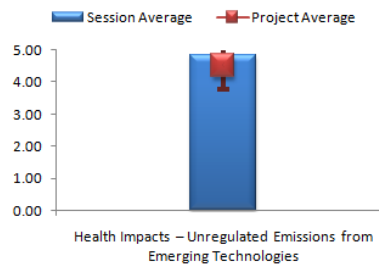
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



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



Question 6: Overall Rating



Health Impacts Research (Doug Lawson of National Renewable Energy 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?

One reviewer commented that this project provides a direct comparison of diesel and gasoline vehicle emissions in the real world. The other person stated that diesel engines present the potential for improved mileage and thus a possibility for reduced petroleum consumption. He adds that health concerns are a critical factor in the use of diesel engines: EPA has set new restrictions on NOx and exhaust particulate matter emissions, at the same time, scientific research has identified possible exacerbated health hazards associated with ultrafine or nanoparticulate exposures. Diesel exhaust particulate is ultrafine in size. It sometimes contains particulate or semi-volatile genotoxicants or other toxic materials, including some traces of metals. While new technologies are being tested by DOE and manufacturers that can control NOx and PM emissions by weight, it is not fully known how the new engines or new control technologies will affect other characteristics of the engine particulate emissions, e.g., increasing numbers of emitted particles, or producing different size distributions or compositions or surface properties of final PM emissions. Such new properties of PM associated with new engine or and control technologies, and new modes of operation, e.g., regeneration, should be evaluated as thoroughly and as early as possible given the possible subsequent rapid and massive public deployment of the technologies. Once again, this is a statement appropriate in general to all the DOE-VT Health Impacts research projects, including this NREL study.

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.

One person stated that this project specifically lists the potential technical barriers and discusses approaches to overcoming those barriers. The other respondent added that this project is one of a set of health impacts studies that are being performed by DOE-VT to better define and address the possibility of new health concerns that might be associated with new engines and control technologies. It is prudent for DOE to undertake these studies to evaluate and guide engine and control technology R&D from the earliest stage. This is a statement appropriate in general to all the DOE-VT Health Impacts research projects, including this NREL study.

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

One reviewer felt that there was excellent progress in all areas. He was especially impressed that this program gets their results into the peer-reviewed literature in a timely manner. The other person stated that studies of the crankcase oil-source of emissions are potentially quite important. He adds that a deuterium tracer is used to apportion total carbon to fuel or oil sources. A priori, it seems likely that the combusted oil will contribute more to the heavier organics and PM in the exhaust, although that distribution and its relative strength compared to the contribution from fuel combustion may be affected by engine tune and operating conditions. However, some level of speciation of the deuterated compounds might indicate an even greater contribution to biologic effects than indicated by mass distribution. Continuing, he states that the weekend ozone effect studies appear profound for understanding mechanisms of environmental air quality. However, they may be a step distant from information useful to direct engine control technology development, in contrast to the lubricant oil component of the study.



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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.

The first respondent stated that the techniques being developed have a very high likelihood of being transferred because they are actively presented at scientific meetings and published in the peer-reviewed literature. The other reviewer added that these collaborations with other institutes and organizations are noteworthy. He adds that the intention for ongoing peer-review publication of results is important. The peer-reviewed publications production on crankcase oil sources of emissions is impressive (though he suggests providing the citations next year).

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

The lone reviewer responding to this question stated that, although this program has made excellent progress with the limited funding they have received, they would make even more progress with additional funding.

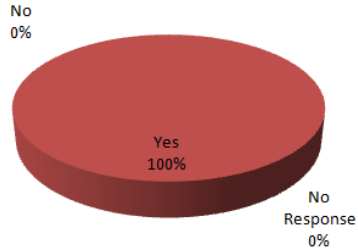
Question 6: Summary rating: when scoring this project, consider the relevance of the work to DOE's objectives, potential impacts on DOE/VT goals, project accomplishments, likelihood of technology transfer, and sufficiency of project resources.

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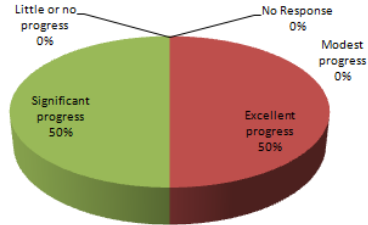


Project: Health Impacts Research

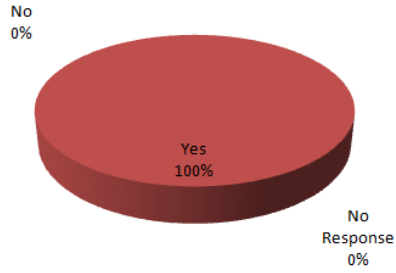
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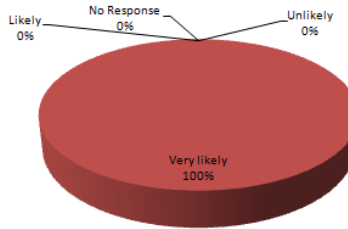
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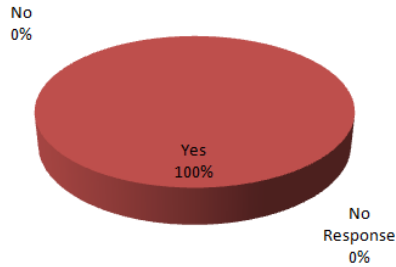
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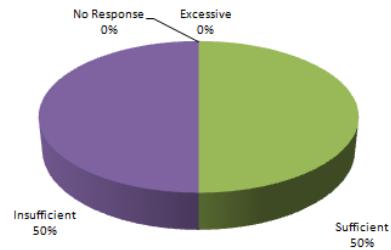
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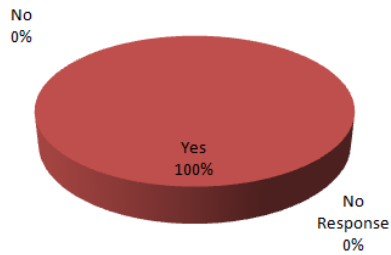
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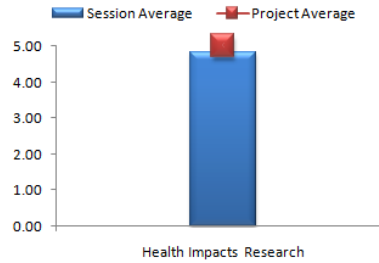
Question 5: Characterize the resources available for this project to achieve the stated milestones in a timely fashion.



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



Question 6: Overall Rating



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