CLEERS Priorities Poll

Response Analysis 2008 (Draft 3.0)

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New West Technologies, LLC
Michael Laughlin

POLL ACTIVITIES SUMMARY

Background of Poll

The Cross-Cut Lean Exhaust Emissions Reduction Simulations (CLEERS) activities began in 2001, with the intention to enhance collaboration among OEMs, emission control suppliers, national laboratories, and universities for emission control research. CLEERS provides a framework for sharing non-proprietary data and simulations and also provides a mechanism for industry feedback to the Department of Energy. The activities are overseen by a CLEERS Planning Committee that implements rules and procedures, updates reports and recommendations to the Crosscut Team, and coordinates CLEERS Focus Groups.

In late 2006, the Department of Energy requested that CLEERS collect information from its partners on recommended research and development priorities for emission controls. The CLEERS Planning Committee undertook the design of the survey questions, the complete list of R&D priorities to be considered, and the list of partners to be surveyed (including Crosscut Team members and emission control suppliers), with a view toward understanding the most important focus areas for which the CLEERS group should apply future resources. A poll was conducted in 2007 and the results reported at several public venues (including DEER).

Poll Changes for 2008

For 2008, the CLEERS Planning Committee made several modifications to the poll questions, specifically designed to simplify the reporting and gather information on technologies through a slightly different set of questions. For 2008, respondents were asked only to prioritize activities on an overall basis, versus prioritizing activities with respect to commercial relevance, national energy strategy, scientific importance, and suitability for National Laboratory capabilities. In addition, specific mention was made in 2008 of diesel oxidation catalysts: for 2007, these were included in a larger category of "integrated systems simulation." Questions for 2008 were also designed to elicit more comments on the need for applications-related work.

As with the 2007 poll, the CLEERS Planning Committee engaged the services of an independent third party, New West Technologies LLC, to conduct the survey in early 2008, analyze the results, and report the results back to the CLEERS group.

In this work, the CLEERS partners were asked to review and prioritize a list of possible future activities and to highlight their three choices for the top priority items. Respondents were also asked to provide suggestions on the recommended balance of funding across several general areas of research. Results were collected separately for diesel and lean gasoline applications (although the lean gasoline work is outside the Crosscut scope). New West developed the electronic survey tools with the assistance of the CLEERS Planning Committee, distributed the tools to the respondents, collected and analyzed responses, and presented the results anonymously to the Committee to protect the identities of the responding companies. This report outlines the procedures and results of the study in more detail.

Because of the short time interval between the 2007 and 2008 polls, some respondents felt that their R&D priorities had not changed significantly. In these cases, the respondents were allowed to reuse their 2007 responses for 2008. Because of the format differences between the 2007 and 2008 questionnaires, the 2007 responses had to be modified slightly to fit the 2008 format. This resulted in some minor inconsistencies in the results, which are highlighted in the analysis below.

SUMMARY OF DIESEL RESPONSES

Summary of Response Rate

There were a total of sixteen responses under the diesel portion of this poll. Responses were received from three engine manufacturers, three light-duty vehicle OEMs, two heavy-duty vehicle OEMs, four major suppliers, and two energy companies (the remaining two responses were 2007 inputs from a supplier and an energy company that were reused for 2008).

Top Priorities

In addition to asking respondents to provide priorities (low/medium/high) to the full list of activities, respondents were also required to pick out the top three choices they felt were the most important priorities to be pursued by research and development. Respondents were allowed to pick from the major technology areas, the technical area subdivisions, and the specific activities for their top priorities. These top three choices were then organized and a weighted average score based on the frequency and position of the response for each technology activity was developed. When 2007 responses were reused, responses from the commercial relevance and scientific importance section were equally weighted for incorporation into the 2008 scoring. The results of this analysis are shown in Table 1, which highlights the six highest-scoring activities in this analysis. As the table shows, responses were generally consistent with the responses from the low/medium/high analysis shown in Table 2 for technical area subdivisions described next.

Table 1: Top Priorities

Priority	Weighted Score (2008)
1. Urea SCR Durability and Poisoning	10
2. Urea SCR Fuel, Reductant, and Reductant Delivery	7
3. (tie) HC-SCR Catalyst Activity	5
3. (tie) Urea SCR Catalyst Activity	5
3. (tie) Urea SCR Fuel, Reductant, and Reductant Delivery: Droplet Vaporization	5
4. Diesel Oxidation Catalyst Durability and Poisoning: Biodiesel Effects	4
5. Lean NOx Trap Durability & Poisoning: Formation and decomposition of sulfates and non-regenerable sulfur	3.5
6. (tie) Diesel Oxidation Catalyst Activity	3
6. (tie) Diesel Particulate Filter Kinetics/Reaction Mechanism	3
6. (tie) Diesel Particulate Filter Kinetics/Reaction Mechanism:	3

Priority	Weighted Score (2008)
Reaction rates for passive and active regeneration of the soot.	
6. (tie) Diesel Particulate Filter Kinetics/Reaction Mechanism: Relationship between soot oxidation kinetics and chemical/morphological properties of soot particles (including particles from advanced combustion and alternate fuels)	3
6. (tie) Diesel Particulate Filter Kinetics/Reaction Mechanism: Capture, generation, and release of nano-particles.	3
6. (tie) Diesel Particulate Filter OBD and Sensors: Accurate estimation of soot loading and prediction of regeneration exotherm.	3
6. (tie) Lean NOx Trap Catalyst Activity	3
6. (tie) Lean NOx Trap Catalyst Activity: Impact of degree of contacting between precious metals and NOx storage sites	3
6. (tie) Lean NOx Trap Kinetics/Reaction Mechanism	3
6. (tie) Urea SCR OBD and Sensors	3

For comparison, the top diesel priorities for CLEERS R&D focus areas in 2007 were:

Commercial Relevance: Diesel Particulate Filters (DPF)/Improved sensor concepts and sensor utilization/Accurate estimation of soot loading and prediction of regeneration exotherm.

Importance to National Energy Strategy: Integrated Systems Simulation (ISS)/Oxidation catalysts/Multi-function (4-way) catalytic systems addressing soot, NOx, CO, and hydrocarbons in a single unit

Scientific Importance/Challenge: Diesel Particulate Filters (DPF)/Kinetics - oxidation mechanisms, detailed kinetics, global rates/Relationship between soot oxidation kinetics and chemical/morphological properties of soot particles (including particles from advanced combustion)

Utilization of Special National Lab Capabilities: Integrated Systems Simulation (ISS)/Device-device interactions (both dynamic and steady-state)/DPF & SCR

As noted above, the four distinct categories for the top priorities were not used in 2008.

Prioritization of Technical Area Subdivisions

Respondents provided scores for the major technical areas (e.g. selective catalytic reduction durability and poisoning, diesel particulate filter OBD and sensing, etc.) as part of their low/medium/high scoring exercise. These scores were averaged across these subdivisions, and the resulting averages were sorted highest to lowest. The top ten subdivisions are shown in Table 2. As this table shows, within the top five choices urea SCR issues dominated the technical area subdivisions, with durability and poisoning the most important issue. DOC and DPF issues were also ranked in the top ten. (This information was not specifically collected from participants in the 2007 poll.)

Table 2: Prioritization of Technical Area Subdivisions

Technical Area Subdivision	Average Score (2008)
1. Urea SCR Durability and Poisoning	2.60
2. Urea SCR OBD and Sensors	2.50
3. Urea SCR Fuel, Reductant, and Reductant Delivery	2.44
4. (tie) DPF Durability and Poisoning	2.40
4. (tie) DPF OBD and Sensors	2.40
5. Urea SCR Kinetics/Reaction Mechanisms	2.33
6. (tie) DPF Kinetics/Reaction Mechanism	2.30
6. (tie) U-SCR Catalyst Activity	2.30
7. (tie) DOC Durability and Poisoning	2.20
7. (tie) U-SCR Integration Strategies	2.20
8. U-SCR Regeneration Strategies	2.10
9. (tie) DOC Catalyst Activity	2.00
9. (tie) DPF Catalyst Activity	2.00
9. (tie) DPF Integration Strategies	2.00
10. (tie) DPF Regeneration Strategies	1.90
10. (tie) HC-SCR Catalyst Activity	1.90
10. (tie) LNT Durability and Poisoning	1.90
10. (tie) LNT Regeneration Strategies	1.90

Prioritization of Specific Activities

Respondents provided scores for the specific activities (e.g. biodiesel effects on DPF regeneration) as part of their low/medium/high scoring exercise. These scores were averaged across these activities, and the resulting averages were sorted highest to lowest. The top ten specific activities are shown in Table 3a. OBD and sensor activities for urea SCR and DPF technologies were most important to respondents.

Table 3a: Prioritization of Specific Activities 2008

Technical Area Subdivision	Average Score (2008)
1. Urea SCR (OBD and Sensors): NOx checking	2.71
2. (tie) DPF (OBD and Sensors): Accurate estimation of soot loading and prediction of regeneration exotherm.	2.67
2. (tie) DPF (OBD and Sensors): Multiple, combined sensor utilization (both existing and new sensors) for loading assessment beyond simple back pressure.	2.67
3. DPF (OBD and Sensors): More reliable, less operation-specific DPF state assessment.	2.58
4. Urea SCR (OBD and Sensors): NH_3 checking	2.57
5. DPF (Kinetics/Reaction Mechanisms): Relationship between soot oxidation kinetics and chemical/morphological properties of soot particles (including particles from advanced combustion and alternate fuels)	2.50
6. DOC (Kinetics/Reaction Mechanisms): NO to NO_2 inter-conversion	2.45
7. (tie) DPF (Durability and Poisoning): Effect of washcoating on DPF thermo-mechanical properties	2.43
7. (tie) DPF (Durability and Poisoning): Biodiesel effects	2.43
7. (tie) LNT (Catalyst Activity): Effect of PGM loading on LNT	2.43

Technical Area Subdivision	Average Score (2008)
performance	
7. (tie) LNT (Regeneration Strategies): Sulfur regeneration	2.43
8. DPF (Kinetics/Reaction Mechanisms): Capture, generation, and release of nano-particles.	2.42
9. (tie) DOC (Fuel, Reductant, and Reductant Delivery): Droplet vaporization	2.38
9. (tie) DPF (Kinetics/Reaction Mechanisms): Role of precious metals in soot oxidation (e.g, other than for NO oxidation)	2.38
10. LNT (Durability and Poisoning): Precious metal aging	2.36

For comparison, the corresponding prioritization of specific activities for the 2007 poll is shown in Table 3b. The scoring procedure used in 2007 determined an overall total score rather than an average, but prioritizations are comparable. These tables illustrate the respondent attitude shift relative to SCR from chemical kinetics and durability toward issues of implementation (like OBD). In addition, OBD appears in several places in the 2008 poll because the keyword OBD was not used directly in 2007, but was used in 2008. As OBD is a difficult issue to attack (especially with respect to NOx and NH_3 sensors), it appears prominently in the responses once that keyword was offered. Note also that there was a much clearer identification of specific activities to undertake in 2008: Tables 3a and 3b contain roughly the same number of entries, but the 2008 table identifies the top ten activities in that space, while in 2007 only the top seven were identified in that space. Also note that in the 2007 poll, the Integrated Systems Simulation (ISS) category included diesel oxidation catalysts, while for 2008 DOC was presented as a stand-alone category, resulting in the appearance of DOCs in the 2008 poll results.

Table 3b: Prioritization of Specific Activities 2007

Technical Area Subdivision	Total Score (2007)
1. SCR (Deactivation Mechanisms): Poisoning by S, P, HCs	37
2. SCR (Deactivation Mechanisms): Effects of soot, ash, coking	36
3. DPF (Improved Sensor Concepts and Sensor Utilization): Accurate estimation of soot loading and prediction of regeneration exotherm	35
4. (tie) DPF (Improved Sensor Concepts and Sensor Utilization): Multiple, combined sensor utilization (both existing and new sensors) for loading assessment beyond simple back pressure.	34
4. (tie) SCR (Deactivation Mechanisms): Thermal degradation due to cycling	34
5. (tie) DPF (Kinetics - oxidation mechanisms, detailed kinetics, global rates): Reaction rates for passive and active regeneration of the soot.	32
5. (tie) DPF (Improved sensor concepts and sensor utilization): More reliable, less operation-specific DPF state assessment.	32
5. (tie) SCR (Global reaction rate equations, including hybrid mechanisms): NH_3 reaction with NO, NO_2	32
6. (tie) DPF (1-D device models (using local properties and kinetics sub-models) for systems simulation.): Models for soot regeneration control studies.	31
6. (tie) ISS (Oxidation catalysts): NO to NO_2 inter-conversion	31

Technical Area Subdivision	Total Score (2007)
6. (tie) ISS (Device-device interactions (both dynamic and steady-state)): DPF/SCR	31
7. (tie) DPF (1.Models for local properties of the filter cake (e.g., permeability, density, morphology)): Variation with time, engine design, operating conditions and fuel formulation.	30
7. (tie) ISS (Oxidation catalysts): Multi-function (4-way) catalytic systems addressing soot, NOx, CO, and hydrocarbons in a single unit	30
7. (tie): SCR (Dosing system): Exhaust gas temperature effects	30

Resource Allocations

Respondents to the polling were asked to provide their assessment of an appropriate resource mix among the major technical areas (urea SCR, DOC, DPF, LNT, hydrogen production/reforming, HC SCR). For data being reused from 2007, responses from the categories common to both polls were used in 2008 analyses (SCR resources were divided equally between U-SCR and HC-SCR for these 2007 responses). The responses were averaged across the respondents, and the resulting average resource allocation is reported below in Table 4a. Urea SCR was judged to require the largest portion of the resources (one-third), with DPFs second at 23 percent. Hydrogen production and reforming was not judged to require much resource investment.

Table 4a: Resource Allocation for Major Technical Areas 2008

Major Technical Area	Portion of Total Resources (2008)
Urea Selective Catalytic Reduction	29%
Diesel Particulate Filters	23%
Lean NOx Traps	19%
Diesel Oxidation Catalysts	13%
Hydrocarbon Selective Catalytic Reduction	13%
Hydrogen Production/Reforming	3%

For comparison, the resource allocation from the 2007 CLEERS poll is shown in Table 4b. Note that a slightly different set of technical areas was provided to poll recipients. The indicated preferences for allocating resources to SCR and DPF were relatively similar between the two polls. The major heading of Integrated Systems Simulation was not included in 2008, but portions of that heading were incorporated into other headings (like diesel oxidation catalysts). New information about interest in HC-SCR was revealed in 2008 as a consequence of including that topic explicitly on the questionnaire.

Table 4b: Resource Allocation for Major Technical Areas 2007

Major Technical Area	Portion of Total Resources (2007)
Selective Catalytic Reduction	30%
Diesel Particulate Filters	29%
Integrated Systems Simulation	25%
Lean NOx Traps	15%

SUMMARY OF GASOLINE RESPONSES

Summary of Response Rate

There were a total of seven responses under the gasoline portion of this poll. Responses were received from two light-duty vehicle OEMs, one major supplier, and one energy company (the remaining three responses were 2007 inputs from a vehicle OEM, a supplier, and an energy company that were reused for 2008). Because of the small sample size (especially related to the sample size for diesel responses), it is difficult to discern small shifts in attitude among respondents. Therefore, the comments that follow will focus on the high-level movements in responses.

Top Priorities

In addition to asking respondents to provide priorities (low/medium/high) to the full list of activities, respondents were also required to pick out the top three choices they felt were the most important priorities to be pursued by research and development. Respondents were allowed to pick from the major technology areas, the technical area subdivisions, and the specific activities for their top priorities. When 2007 responses were reused, responses from the commercial relevance and scientific importance section were equally weighted for incorporation into the 2008 scoring. These top three choices were then organized and a weighted average score based on the frequency and position of the response for each technology activity was developed. The results of this analysis are shown in Table 5, which highlights the five highest-scoring activities in this analysis. In this table, lean NOx trap issues are the most prominent, with an appearance by the urea SCR issues as well. This response was somewhat inconsistent with the focus areas identified in the other tables that follow, but the small sample size for the gasoline responses makes it more difficult to discern shifts in priorities.

Table 5: Top Priorities

Priority	Weighted Score
1. LNT Catalyst Activity	6
2. LNT Durability and Poisoning	5
3. LNT Kinetics/Reaction Mechanism: Formation of NH_3, N_2O, HCN, and isocyanates	3.5
4. (tie) LNT Kinetics/Reaction Mechanism: NO and NO_2 reduction by CO, H_2, and HC (separately)	3

Priority	Weighted Score
4. (tie) Urea SCR Durability and Poisoning: Thermal degradation due to cycling	3
5. (tie) LNT Kinetics/Reaction Mechanism	2
5. (tie) Urea SCR Durability and Poisoning: Sulfur Poisoning	2

In 2007, the top priorities question was asked in a slightly different manner, as respondents were asked to provide their specific priorities (versus major technology area priorities) in several specific areas (versus simply their overall priorities). The top priorities for CLEERS focus areas for gasoline for 2007 were:

Commercial Relevance: (tie) Integrated Systems Simulation (ISS)/oxidation catalysts/multi-function (4-way) catalytic systems addressing soot, NOx, CO, and hydrocarbons in a single unit AND Lean NOx Traps (LNT)/Determination and characterization of limiting chemical or physical mechanisms for precious metal aging

Importance to National Energy Strategy: (tie) Integrated Systems Simulation (ISS)/oxidation catalysts/multi-function (4-way) catalytic systems addressing soot, NOx, CO, and hydrocarbons in a single unit AND Lean NOx Traps (LNT)/Determination of the elementary reaction steps for NO, NO_2, and O_2 storage and release

Scientific Importance/Challenge: Lean NOx Traps (LNT)/Determination of the elementary reaction steps for formation of NH_3, N_2O, HCN, and isocyanates

Utilization of Special National Lab Capabilities: Lean NOx Traps (LNT)/Determination of the elementary reaction steps for formation of NH_3, N_2O, HCN, and isocyanates.

Prioritization of Technical Area Subdivisions

Respondents provided scores for the major technical areas (e.g. selective catalytic reduction durability and poisoning, particulate filter OBD and sensing, etc.) as part of their low/medium/high scoring exercise. These scores were averaged across these subdivisions, and the resulting averages were sorted highest to lowest. The top four subdivisions are shown in Table 6. LNT issues are high on this list, with durability and poisoning at the top. Urea SCR was also very important to respondents in 2008. Hydrocarbon SCR was also toward the top of the list, with issues of activity and durability being important. Given the small sample size, all of the technical area subdivisions in Table 6 could be judged as being of very similar relative importance.

Table 6: Prioritization of Technical Area Subdivisions

Technical Area Subdivision	Average Score (2008)
1. (tie) LNT Durability and Poisoning	3.0
1. (tie) Urea SCR Durability and Poisoning	3.0
2. Urea SCR Catalyst Activity	2.7
3. (tie) LNT Catalyst Activity	2.5
3. (tie) LNT Regeneration Strategies	2.5

Technical Area Subdivision	Average Score (2008)
3. (tie) Urea SCR Integration Strategies	2.5
4. (tie) HC-SCR Catalyst Activity	2.3
4. (tie) HC-SCR Durability and Poisoning	2.3
4. (tie) LNT Integration Strategies	2.3
4. (tie) Urea SCR OBD and Sensors	2.3

Prioritization of Specific Activities

Respondents provided scores for the specific activities (e.g. biodiesel effects on DPF regeneration) as part of their low/medium/high scoring exercise. These scores were averaged across these activities, and the resulting averages were sorted highest to lowest. The top five specific activities are shown in Table 7a. Note that here, in contrast to Table 6, hydrocarbon SCR issues (especially activity and durability) were higher on the list, but in the same general scoring level as lean NOx trap and urea SCR issues. This discrepancy can mainly be explained by the small sample size: at the response rate for gasoline, all of these issues are of similar importance.

Table 7a: Prioritization of Specific Activities 2008

Technical Area Subdivision	Average Score (2008)
1. (tie) HC-SCR (Catalyst Activity): Low temperature light-off	3.00
1. (tie) HC-SCR (Catalyst Activity): Wider operating temperature window	3.00
1. (tie) HC-SCR (Durability and Poisoning): Temperature and composition for thermal degradation	3.00
1. (tie) HC-SCR (Durability and Poisoning): Phosphorous poisoning	3.00
1. (tie) HC-SCR (Durability and Poisoning): Sulfur poisoning	3.00
1. (tie) LNT (Catalyst Activity): Low temperature light-off	3.00
1. (tie) LNT (Catalyst Activity): Effect of PGM loading on LNT performance	3.00
1. (tie) LNT (Regeneration Strategies): Sulfur regeneration	3.00
1. (tie) Urea SCR (Catalyst Activity): Low temperature light-off	3.00
1. (tie) Urea SCR (Catalyst Activity): High temperature performance improvement	3.00
1. (tie) Urea SCR (Durability and Poisoning): Temperature and composition for thermal degradation	3.00
1. (tie) Urea SCR (OBD and Sensors): NOx checking	3.00
1. (tie) Urea SCR (OBD and Sensors): NH_3 checking	3.00
2. LNT (Durability and Poisoning): Precious metal aging	2.83
3. LNT (Regeneration Strategies): Release of stored NO, NO_2, and O_2 during rich conditions	2.75
4. (tie) LNT (Kinetics/Reaction Mechanisms): Formation of NH_3, N_2O, HCN, and isocyanates	2.67
4. (tie) LNT (Regeneration Strategies): Reduction of NO and NO_2 by CO, H_2, and HC during rich conditions	2.67
4. (tie) LNT (Regeneration Strategies): Release of SO_2, SO_3, and H_2S during desulfation	2.67
5. (tie) LNT (Kinetics/Reaction Mechanisms): Release of stored NO, NO_2, and O_2 during rich conditions	2.60

For comparison, the corresponding prioritization of specific activities for the 2007 poll is shown in Table 7b. The scoring procedure used in 2007 determined an overall total score rather than an average, but prioritizations are comparable. Hydrocarbon SCR issues were much more prominent in the 2008 poll, which may indicate industry attitudes toward hydrocarbon SCR as the most workable solution for NOx control, if the technology could be made to work well in the application.

Table 7b: Prioritization of Specific Activities 2007

Technical Area Subdivision	Total Score (2007)
1. (tie) LNT (Determination/characterization of limiting chemical or physical mechanisms for): Precious metal aging	17
1. (tie) LNT (Chemistry and kinetics common to LNT's and 3-way catalysts): Consumption of H_2, CO, and HC during rich conditions and lean-rich transients	17
2. (tie) LNT (Determination of the elementary reaction steps for): NO, NO_2,and O_2 storage and release	16
2. (tie) LNT (Determination of the elementary reaction steps for): NO, NO_2 and O transport between PGM adsorption and storage sites	16
2. (tie) LNT (Chemistry and kinetics common to LNT's and 3-way catalysts): Release of stored NO, NO_2, and O_2 during rich conditions	16
2. (tie) LNT (Chemistry and kinetics common to LNT's and 3-way catalysts): Reduction of NO and NO_2 by CO, H_2, and HC during rich conditions	16
3. (tie) LNT (Determination of the elementary reaction steps for): Formation of NH_3, N_2O, HCN, and isocyanates	15
3. (tie) LNT (Chemistry and kinetics common to LNT's and 3-way catalysts): Production of NH_3 and N_2O during rich conditions and lean-rich transitions	15
4. (tie) LNT (Determination of the elementary reaction steps for): NO and NO_2 reduction by CO, H_2, and HC (separately)	14
4. (tie) LNT (Determination of the elementary reaction steps for): Formation and decomposition of sulfates	14
4. (tie) LNT (Determination/characterization of limiting chemical or physical mechanisms for): H_2O and CO_2 inhibition	14
4. (tie) LNT (Determination/characterization of limiting chemical or physical mechanisms for): Formation of non-regenerable sulfur	14
4. (tie) LNT (Determination/characterization of limiting chemical or physical mechanisms for): Degree of contacting between precious metals and NOx storage sites	14

Resource Allocations

Respondents to the polling were asked to provide their assessment of an appropriate resource mix among the major technical areas (urea SCR, DOC, DPF, LNT, hydrogen production/reforming, HC SCR). The responses were averaged across the respondents, and the resulting average resource allocation is reported below in Table 8a. The emphasis on lean NOx traps for resource allocations (suggested resource allocation is almost half toward LNT) is somewhat inconsistent with the emphasis areas outlined by respondents in other areas of the poll. Again, the small sample size in this section could explain the seeming discrepancy.

Table 8a: Resource Allocation for Major Technical Areas 2008

Major Technical Area	Portion of Total Resources (2008)
Lean NOx Trap	63%
Urea Selective Catalytic Reduction	21%
Hydrocarbon Selective Catalytic Reduction	8%
Particulate Filters	7%
Hydrogen Production/Hydrocarbon Reforming	1%
Oxidation Catalysts	0%

For comparison, the resource allocation from the 2007 CLEERS poll is shown in Table 8b. Note that a slightly different set of technical areas was provided to poll recipients. Also note that SCR was judged to be more important in the 2008 poll relative to 2007.

Table 8b: Resource Allocation for Major Technical Areas 2007

Major Technical Area	Portion of Total Resources (2007)
Lean NOx Traps	61%
Particulate Filters	20%
Integrated Systems Simulation	16%
Selective Catalytic Reduction	4%

MAJOR HIGHLIGHTS OF POLL FINDINGS

From the responses received from the diesel engine community, the following key observations were revealed:

- There has not been any major shift in priorities between 2007 and 2008.
- OBD (especially for urea-SCR) is emerging as a topic area of growing concern.
- There is a continuing interest in HC-SCR, apparently from a long-range perspective.
- Interest in DPF issues appears to have waned slightly, possibly as the result of increased experience with the technology.
- DOC needs and concerns are more apparent as a result of the 2008 survey.

For the lean gasoline community, the following key points are apparent:

- LNT technology is still the general area with the greatest needs and concerns
- Interest in urea-SCR is growing
- As with the diesel community, there is a long-range interest in HC-SCR.
- Interest in DPF technology is low.