UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

SEP 11 2008

OFFICE OF
RESEARCH AND DEVELOPMENT

Gary S. Sayler, Ph.D.
Chair, Board of Scientific Counselors
Center for Environmental Biotechnology
The University of Tennessee
676 Dabney Hall
Knoxville, TN 37996

Dear Dr. Sayler:

On July 24-25, 2007, a standing subcommittee of the Board of Scientific Counselors (BOSC) met in Washington, DC to evaluate the Office of Research and Development's (ORD) National Center for Environmental Research (NCER). Specifically, the standing subcommittee evaluated NCER's capabilities in three specific areas: 1) flexibility in addressing emerging issues; 2) effectiveness of communications; and 3) metrics to measure impacts. The standing subcommittee presented a report of its findings and recommendations to the Executive Committee of the BOSC in January 2008, and the Executive Committee, in turn, provided a final BOSC report to ORD on March 26, 2008. With this letter, I am pleased to enclose the Agency's response to the final BOSC report of its review of NCER.

The National Center for Environmental Research (NCER) greatly appreciates the insights, advice, and recommendations offered by the BOSC. The attached narrative presents an overview of specific recommendations made by the BOSC and includes NCER's responses to each. In addition, NCER has provided a table that summarizes each recommendation, the action to be taken, and a schedule for completion of the proposed actions.

As you are aware, ORD conducts periodic evaluations of its research programs' progress at intervals of four to five years. The purpose of these reviews is to determine progress with regard to relevance, quality, performance, and scientific leadership. The reviews also focus on identifying how the scientific community and programmatic clients utilize ORD's scientific outputs to protect human health and the environment. In addition to these programmatic reviews, ORD has begun to evaluate its individual Laboratories and Centers through the use of BOSC standing subcommittees. The periodic reviews by standing subcommittees provide critical feedback to the Labs/Centers regarding their progress towards meeting internal and ORD-wide strategic goals as well as the extent to which recommendations from previous reviews are being met. The timing for the next review of NCER's strategic goals and operations

will likely occur in 2009. In this context, we look forward to the possibility of working with you and other members of the Subcommittee again.

Sincerely,

for Kevin Y. Teichman, Ph.D.
Deputy Assistant Administrator for Science

Enclosure

cc: William Sanders
Alva Daniels

Office of Research and Development's (ORD) National Center for Environmental Research (NCER) Response to the Board of Scientific Counselors (BOSC) Standing Sub-Committee Review Report September 2008

Submitted by:
William H. Sanders III, Dr.P.H., Director
National Center of Environmental Research

ORD Response to Recommendations from the BOSC Standing Sub-Committee Review for the National Center for Environmental Research

The U.S. Environmental Protection Agency's (EPA) Office of Research and Development (ORD) rely on its Board of Scientific Counselors (BOSC) to conduct independent expert reviews of its environmental research programs every four to five years. At the request of Dr. Kevin Teichman, Deputy Assistant Administrator for Science, Office of Research and Development (ORD), the Executive Committee of the U.S. Environmental Protection Agency's (EPA) Board of Scientific Counselors (BOSC) constituted a Standing Subcommittee to provide periodic review of ORD's National Center for Environmental Research (NCER). The charge developed and submitted by the NCER leadership was as follows:

> **What steps can NCER take to more effectively engage the external scientific community to better craft a forward-looking portfolio and meet evolving Agency needs?**

There were three specific questions associated with the charge which were:

> **1. Regarding NCER's niche in ORD and in the greater environmental federal research and development realm, what can it do to more flexibly address emerging issues and technologies and provide timely responses to rising scientific needs of the Agency?**
>
> **2. What advice can be offered on ways to measure and improve the effectiveness of NCER's communication so that decision-makers will make greater use of NCER's products?**
>
> **3. What metrics are most useful for measuring the impact of NCER's work?**

The Subcommittee operated under applicable Federal Advisory Committee Act (FACA) rules and completed its review with one face-to-face meeting with the leadership and staff of NCER held in Washington, DC (July 24-25, 2007) and four teleconferences (July 13, 2007; September 11, 2007; November 1, 2007; and December 14, 2007).

The purpose of the following narrative is to respond to the recommendations made in the *Final Letter Report of the Periodic Review of the Office of Research and Development's National Center for Environmental Research (NCER) at the US Environmental Protection Agency*, dated March 26, 2008. In addition, NCER has provided a summary table of Proposed Actions which coincide with the responses to each of the sub-committee's recommendations.

In its final Letter Report, the BOSC Standing Subcommittee applauded NCER for its ongoing efforts to increase its relevance to the Agency's mission and other components of the EPA. In the face of limited resources, the Subcommittee "heartily recognized the extraordinary efforts that already have been made to reach the largest audiences possible".

In response to the charge question and supporting questions, the BOSC made a series of recommendations (pages 2-4 of the final Letter Report) to NCER to "create a proactive research agenda that is responsive to input from a wide variety of stakeholders and scientific experts". These 16 recommendations were categorized by the BOSC into three overarching themes:

1. **Priority Setting**
2. **Frontiers**
3. **Measuring Impacts**

The sub-committee emphasized throughout its Letter Report the importance "placed on qualitative and quantitative metrics that enable the Center and the Agency to identify and set priorities that stimulate innovation and discovery, assess achievement and impact in traditional areas of research, and determine the wider effects on policy and improvements in environmental quality".

In the area of priority setting, the Subcommittee suggested:

> **Recommendation 1:** ORD should generate a prioritized list of metrics that may be used to evaluate the need to address emerging issues.

Response: NCER believes this recommendation should be addressed by ORD's senior science and management leadership. NCER recommends the sub-committee consult with the BOSC Executive Committee regarding approaches to developing a prioritization methodology for ORD's research portfolio.

> **Recommendation 2**: NCER should initiate a dialogue with EPA program offices and with outside stakeholders about what information is most needed for their mission.

Response: NCER agrees that ORD should establish a standardized approach for initiating and tracking communication and outreach efforts within the organization itself, Program Offices and Regions. The Center also participates in ORD's research planning process, led by ORD's National Program Directors (NPDs), where research needs are

identified and discussed on an on-going basis with the EPA's Program and Regional Offices.

All of ORD's Research Programs (e.g., Drinking Water, Human Health, Air, Global Change, etc.) use Research Coordination Teams (RCT) to develop, plan, communicate, and review ORD's research programs. This process is integral to identifying research that can best be accomplished through the STAR grants mechanism. Once these priority research areas are identified, NCER staff work with the RCT representatives or other identified program/regional office representatives to write Request for Applications (RFAs).

One area of improvement within the ORD Planning Process that NCER is considering is to establish a standardized cradle-to-grave RFA approach for initiating and tracking communication and outreach efforts with ORD, Program Offices and Regions which is a critical component to the success of the NCER research program. While it is vital to receive Program and Regional Office input during the RFA writing stage, it is even more important to ensure that we continue to share and communicate results throughout the life of a grant or suite of grants to ensure that these partners remain involved in the grants progress.

> **Recommendation 3**: NCER should fund "meta-research" into value-of-information theory, software, and training.

Response: NCER agrees with the BOSC's suggestion that EPA would benefit from further research into the use of "value of information" (VOI) techniques. VOI's benefits would redound both to EPA's regulatory functions (by helping to evaluate the sufficiency of the evidence on hand), as well as to its research programs (by helping to assess the most appropriate areas for research). ORD currently coordinates a cross-Agency workgroup tasked with identifying available tools and research needs associated with "probabilistic risk assessment," a broad topic that includes VOI and other analytical approaches to address scientific uncertainty. NCER is not the lead on this effort, but it will continue to work with this workgroup in its efforts to engage the Agency in formal methods to incorporate uncertainty in regulatory decision-making.

> **Recommendation 4**: NCER should increase its efforts on cross-media, multiple-substance, and life-cycle research.

Response: NCER agrees with the BOSC subcommittee that it should increase investments in more integrated cross-media, multiple-substance and life-cycle research. NCER integrates cross-media and multiple-substance research activities into its programs primarily through the annual planning process and discussion with the National Program Directors. Decisions are based on the scope of the issue, the nature of the chemical class or toxicity effect, and resources available for redirection.

NCER has sponsored cross-media research in recent years. The Centers for Children's Environmental Health and Disease Prevention Research ("Children's Centers") have

examined the health effects of a wide range of chemicals including pesticides, metals, air pollutants and others. Other RFAs have looked at the nexus between ecological research and economics. The STAR Global Change Research program has recently funded a number of new multi-pollutant projects examining the effects of climate change on air quality, including ozone, particulate matter, and mercury.

In future years, NCER is planning RFAs that are cross-media and/or examine the effects of exposure to multiple substances. For example, NCER's Drinking Water Program has increased its research emphasis on source water protection, distribution systems, and microbial risk characterization in alignment with the ORD DW Research Program's strategic vision of focusing more on addressing concurrent and cumulative exposure to multiple chemical and microbiological contaminants. An upcoming RFA on community-based cumulative risk assessment will look at multiple chemicals in multimedia across various age groups and geographic locations. The STAR Air Program is moving toward a multi-pollutant approach, in its support of research examining health effects of near-road exposures. In addition, the Air Program has sought a review from the Science Advisory Board on its Particulate Matter (PM) Research Centers, specifically requesting input on moving toward a multi-pollutant focus. Lastly, initial Computational Toxicology (CompTox) research efforts were chemical specific and limited to pesticides, but that program is now expanding to include the development of complex predictive models which investigate the mechanistic characteristics of a variety of chemicals.

In the life-cycle analysis (LCA) research area, NCER has developed a number of engineering based projects involving LCA. For example, the Center has funded research focused on studying the life-cycle impacts of biofuels. For more information, please see the response to Recommendation 5.

> **Recommendation 5:** NCER should balance its extramural research portfolio by funding some social science, cognitive science, and engineering research.

Response: NCER agrees that social and cognitive sciences are important areas of research and it has funded this work in the past. However, with respect to the BOSC recommendation to fund social and cognitive sciences research, since FY2008, these areas of research have been funded by the National Center for Environmental Economics (NCEE) in the Office of Policy, Economics, and Innovation (OPEI). It is our understanding that NCEE has incorporated this body of research into its Economics and Decisions Sciences program and fully intends to continue funding research in these areas.

NCER is very interested in funding related research in other areas that complement NCER's existing research portfolio. For example, NCER supports small business engineering research and development through the Small Business Innovative Research (SBIR) Program. Topics covered in SBIR include: innovation in manufacturing, nanotechnology, green buildings, and monitoring and control of air pollution.

NCER also has a history of supporting academic engineering and physical science research more broadly. From 1995 to 2003, NCER partnered with the National Science Foundation (NSF) to sponsor the Technology for a Sustainable Environment (TSE) research grants program. Together, the two organizations invested over $57 million (NSF: $30.9 million; EPA $26.8 million) in academic research that helped to build the fields of green engineering and green chemistry. (See information on TSE at: http://es.epa.gov/ncer/science/tse/decade_innovation.pdf). Currently, NCER is supporting academic engineering research through the Drinking Water program on the topic of water infrastructure sustainability. (See 2008 solicitation information at: http://es.epa.gov/ncer/rfa/.)

In addition, the TSE program supported early LCA work that incorporated agricultural practices into a comparison of bio-based and petroleum-based feedstocks. Further research is needed to understand the various environmental impacts of alternative energy sources over the full life cycle and to enable green design and engineering principles to be embedded into new chemicals, materials, processes and systems as they are developed. These topics align with pending FY2009 ORD budget initiatives.

> **Recommendation 6:** NCER should consider using an unsolicited grant submission process to encourage the generation of relevant scientific questions that do not match the exact wording of existing Requests for Applications (RFAs).

Response: The goal of our extramural grant program is to encourage the generation of innovative research proposals that address scientific uncertainties that are relevant to EPA's mission. NCER historically has not supported the funding of unsolicited proposals. NCER's mission is to support research grants and graduate fellowships in numerous environmental science and engineering disciplines through a *competitive* solicitation process and independent peer review. Establishing an unsolicited grant submission process would also be inconsistent with the overall mission of NCER and EPA's policy to promote competition to the maximum extent practicable in the award of assistance agreements.

The Agency's Competition Order (http://www.epa.gov/ogd/competition/5700_5A1.pdf) places restrictions on funding assistance agreements that are not competed. Any assistance award made in excess of $15,000 must be competed. The Order does allow for certain exceptions, such as support for unsolicited proposals, but the intent of the exception is to allow an EPA office to fund a *specific* proposal it deems unique or innovative as opposed to establishing a process to fund *multiple* non-competitive unsolicited proposals. Further, the unsolicited proposal must "not resemble the substance of a pending or contemplated competitive announcement." While the BOSC subcommittee recommendation asks NCER to "encourage" the generation of additional relevant scientific questions, the Competition Order states that "No EPA employee may take action to directly or indirectly *encourage the submission of unsolicited proposals*."

In the area of Frontiers, the subcommittee suggested:

> **Recommendation 7**: NCER should use the "grant summaries" and "state-of-the-science papers" to begin a dialogue about important gaps in decision-relevant information with EPA decision-makers and external scientists.

Response: NCER agrees that the grant summaries and state-of-the-science reports provide a valuable means of communicating our research results, and certainly NCER should make additional efforts to ensure that these reports reach potential users, including decision-makers and scientists. In addition to providing research findings, these reports contribute to discussions about research gaps.

NCER staff work with ORD's National Program Directors (NPDs) to identify research needs. The NPDs are responsible for overall coordination of the research program, including interaction with the EPA Program and Regional Offices to identify research needs. ORD has found that it is much more productive for the Program and Regional Offices to discuss important gaps in decision-relevant information with ORD collectively, rather than with each individual research Lab and Center separately. Thus, while NCER can engage in communication of research results to decision-makers, it is best to do so in the context of research results from all of ORD's Labs and Centers.

In this broader context, NCER agrees with the Committee's recommendation that additional efforts are needed by ORD as a whole to interact with EPA offices and with the external scientific community. Thus, the NCER Director is committed to working with NPDs to host "futures" discussions using not only NCER science summaries, but other relevant science assessments.

In addition, NCER will continue its efforts to hold sessions at scientific society meetings to discuss key findings and emerging science issues.

Together with the NPDs, the NCER Director will consider formalizing processes such as:

- Holding a series of Division Director level meetings between ORD and Program/Regional Offices to illustrate ORD accomplishments (e.g., NCER state- of-the-science reports), and

- Encouraging ORD to lead cross-Agency efforts, involving multiple program offices and regions, to identify emerging issues.

> **Recommendation 8**: NCER should seek input on possible emerging areas of science from a broader community of stakeholders, not simply from funded scientists.

Response: NCER agrees that it is critical to seek input on emerging areas of science from a broader community of stakeholders than its funded scientists. However, perhaps NCER's ongoing efforts to do so were not clearly stated at the BOSC review in 2007.

Ongoing efforts include interactions of project officers with scientists engaged in cutting-edge research at professional conferences. Project officers regularly attend these meetings and interact with other scientists both informally and at presentations in order to remain current on emerging areas in their disciplines. This effort could be enhanced further by project officers chairing sessions at professional meetings, which would specifically focus on seeking input for new areas for RFAs.

NCER has also been successful engaging the greater community of stakeholders by holding national workshops. Examples include a September 2007 workshop on the public health applications of human biomonitoring, which was cosponsored by NCER and the International Council of Chemical Associations. The workshop was attended by 191 representatives from industry, academia, media, non-governmental organizations (NGOs), and various government agencies. In October 2007, NCER sponsored a national workshop to seek input on research needs for community-based risk assessments. This workshop was attended by 85 representatives from EPA, other government agencies, academia, and other research groups, and community advocacy groups. These workshops will continue to be a tool for engaging the greater scientific community in identifying possible emerging areas for NCER's research program.

Another example is NCER's nanotechnology program, where involvement with a wide variety of stakeholders was deemed necessary due to the interdisciplinary nature and complexity of this new field, the high level of interest, and the collaborative aspects on the federal agency level (National Nanotechnology Initiative). As a result, research priorities and RFAs have involved other federal agencies, international organizations, non-governmental organizations, industrial corporations and media organizations. This enables the program to speak to a variety of interests and although these groups are quite diverse, there is a general consensus on the human health and environmental issues that require additional research.

NCER also collaborated with the Agency for Toxic Substances and Disease Registry (ATSDR) by jointly issuing an RFA in 2002 on the topic of Lifestyle and Cultural Practices of Tribal Populations and Risks from Toxic Substances in the Environment. This RFA solicited research on the development of: 1) exposure and effects assessment methods that can be broadly applied across geographic regions and cultural practices, and 2) risk management strategies and options that will lead to reduction in risk from exposure. Because this was a new area of research, it was necessary to work with another stakeholder in order to ensure greater input. As a result of the first solicitation, NCER was able to issue a second RFA in this area in 2007.

NCER will continue to work with other stakeholders in issuing RFAs, particularly when seeking input on a new area of research.

> **Recommendation 9**: NCER should revitalize the Exploratory Grant mechanism and expand it considerably from its current sole focus on nanotechnology.

Response: Prior to 1995, EPA's research grants program was described as entirely exploratory. Exploratory research is fundamental to NCER's mission. NCER programs have the flexibility year by year to be more immediately responsive at targeting research at the environmental concern of the day or at issues that may be less clearly defined and/or further out in time. The NCER exploratory program has traditionally solicited open, investigator-initiated projects that apply new, novel, and highly innovative approaches to address environmental issues or the scientific or engineering principles that underlie them. Initial exploratory RFAs were in broad areas such as "chemistry," "geology", and "human health" and generated a large number of proposals. Since then, NCER has attempted to make the Exploratory RFAs more narrowly focused on emerging topics. Exploratory research solicitations in the past have resulted in an overwhelming number of applications, many of which were poorly focused. This required extensive resource commitments just to conduct the peer reviews and resulted in a low percentage of applications being awarded grants (e.g., of 1,000 proposals received, only 10 grants could be awarded). To date, NCER has released 33 separate solicitations (RFAs) under the Exploratory Research program (see table of Exploratory Research RFAs).

For the past three years, the exploratory program has been devoted almost entirely to nanotechnology research. As nanotechnology moves from being an exploratory effort to its own free-standing program, options to re-invigorate the program are being explored by a NCER staff workgroup. The workgroup may consult with outside advisory groups (e.g., SAB, BOSC) for their input on new topics for exploratory research.

In the area of Measuring Impacts, the subcommittee suggested:

> **Recommendation 10**: NCER should expand the use of bibliometrics to analyze citations to identify audiences and estimate the use of research results by other scientists.

Response: NCER has the lead for conducting bibliometric analyses of all of ORD's research programs. NCER agrees that ORD's use of bibliometrics should be expanded and adapted to stay on the cutting edge of use of citation analysis as a metric. As NCER relayed to the BOSC however, advanced bibliometric analyses are expensive and resource intensive.

As part of this effort, the Center experimented with advanced bibliometrics in the past – an analysis was conducted on 1.4% of our Particulate Matter research program publications (13 journal articles) from which about 60% of the citing papers were analyzed (647 papers). This exercise identified alternate audiences, and attempted to analyze how results were being used by citing researchers. The analysis also included a secondary citation analysis of citing authors. The cost for this single exercise exceeded $60K. Therefore, identification of audiences and determining how the citing researchers are using the results can only be considered on a very limited basis using very small subsets of data despite the fact that using small sample sizes can invoke arguments of accuracy and statistical defensibility.

NCER will continue to conduct audience analyses for the citing universe of only the very highly cited publications and on a limited basis to assess whether these results would be statistically relevant. NCER will also analyze a small subset (smaller than the example referenced above) of this citing universe to make a limited determination of how the research results were used.

NCER will also re-explore the viability of adapting existing COTS text mining software, such as Attensity, to help automate this type of analysis, and experiment with affiliation analysis of co-authors to determine whether that is a relevant indicator of collaboration activities.

NCER is also researching the use of additional bibliometric parameters for inclusion in its research program bibliometric analyses. Parameters currently under consideration include: H-Index; Scopus-Scimago; Mathew value; publication rates; Google Scholar Page Rank, and others.

> **Recommendation 11:** NCER should expand the use of data-mining tools to connect research with immediate outcomes.

Response: NCER agrees that its use of internal data mining should be increased to identify immediate regulatory and policy outcomes for all of ORD's research programs. NCER has developed a tool that allows batch searching of our principal investigator publications within the EPA dockets and Web Inventory. The output from this tool is then manually culled to identify program office publications, policy, or rulemaking documents.

NCER has modified its bibliometric process to include an internal data mining analysis to identify rulemaking and policy actions as immediate outcomes. As discussed above, NCER will re-evaluate the use of these tools on external publications as well.

> **Recommendation 12**: NCER should develop case studies of how research funded by the Center facilitates change in tangible indicators of environmental performance ("results"), in addition to how the research is cited, read, and otherwise increases knowledge.

Response: NCER agrees with the recommendation and has begun internal discussions to develop a template for producing "case-study" and "summary analysis" documents that interpret NCER/ORD research results and present the findings in a user-oriented format for a variety of audiences. Initial target programs include linking ecological assessment indicators research that was funded through the STAR program's Ecological Research Program with ecological condition indicators identified in the EPA's 2008 Report on the Environment (ROE). Correlations such as these can assist the Agency and others in determining and maintaining the vitality of ecosystems even when they are being stressed by anthropogenic activities.

Recommendation 13: NCER should consider the implementation of user/client interviews to collect impact feedback.

Response: ORD conducts biennial partner surveys for each of its major research programs. Survey results are analyzed to determine whether ORD's partners find ORD research to be timely, relevant, and of high quality. The surveys also help determine the extent to which partners use ORD's research in their decisionmaking. Because NCER's research supports the goals of ORD's research programs, it is included in the research assessed as part of ORD's program-level partner surveys.

Recommendation 14: NCER should consider the use of expert reviews to assess broad scientific impact and program success.

Response: The need to effectively measure program success and assess research impact continues to be a challenge for many in the Federal sector. ORD recognizes the value in expert reviews and the importance of seeing its internal operations from an external viewpoint. The ORD/NCER research programs have been the subject of a number of such expert panel reviews (e.g., the National Research Council, 2000). The majority of these types of reviews have focused on broader research areas, and have been conducted in conjunction with ORD's overall research planning and prioritization process (e.g., SAB reviews of NCER's Children's Heath Research Centers and PM Research Centers). In the future, NCER will seek evaluation of its more "independent" program areas. For example, there are plans to conduct evaluations of the Fellowships Program in 2009.

Recommendation 15: NCER should consider implementation of cost-benefit analyses to measure return on investment.

Response: NCER believes a cost-benefit analysis that includes an assessment of past investments in its research programs relative to the productivity levels of them is a useful exercise. This information can be used in concert with priority setting exercises to assist in determining the strategic direction of its research programs. The Center is in the process of completing a Return on Investment (ROI) analysis of its research portfolio encompassing the past 5 years of grants research activities and its Fellowship Programs. The initial analysis will focus on NCER's research activities in each of ORD's research programs but will be expanded to include ORD's intramural research activities and associated productivity levels as well in the future.

Recommendation 16: NCER should use a broader approach than currently is used to demonstrate the links between NCER research and other approaches beyond rulemaking.

Response: To better assess NCER's grants management effectiveness, NCER might experiment lengthening the time horizon for the bibliometric analysis and monitor whether NCER funded research has/is resulting in changes in science and engineering.

For example, NCER agrees with the Subcommittee that we need to undertake a more thorough look at the impact of technologies funded through the Small Business

Innovation Research (SBIR) Program. In future reviews of technologies, NCER will request information on patents as well as revenues associated with sales, licenses, and other commercialization success. NCER will also track investments in SBIR technologies by venture capital, angel investors, and other partners. Success stories can be used to describe and track technologies with large impacts.

The Center also agrees that it is important to expand its communicative interactions with the Program and Regional Offices as well as outside stakeholders to gain a better understanding of linkages between their respective missions and NCER. For discussions internal to EPA, NCER believes these should occur through ORD's Multi-year Planning Process, which is lead by ORD's NPDs to identify research needs. To effectively communicate with the external scientific community, NCER sponsors and/or co-sponsors post grant award scientist-to-scientist or All-Investigator Meetings/Workshops that include participation from grantees, EPA scientists, and other external researchers and stakeholders in an effort to communicate results and identify research gaps and potential future areas of research.

Lastly, NCER hosts Regional meetings and workshops that focus on communication of those STAR results that impact the specific Region. These meetings also provide an opportunity to hear the Region's most pressing needs and research issues.

National Center for Environmental Research
Summary of Recommendations and Proposed NCER/ORD Actions and Timelines

Recommendation	NCER Action	TimeLine for Action
1. ORD should generate a prioritized list of metrics that may be used to evaluate the need to address emerging issues.	Applicable to all of ORD.	Referred to BOSC Exec. Comm. For discussion with ORD leadership.
2. NCER should initiate a dialogue with EPA program offices and with outside stakeholders about what information is most needed for their mission.	NCER will develop & implement a communication strategy to disseminate results and solicit new research areas.	Communication Strategy will be finalized by June 30, 2009.
3. NCER should fund "meta-research" into value-of-information theory, software, and training.	NCER and ORD will collaborate with Agency workgroups to develop VOI theory and utilize the resultant data.	When requested to do so by the Agency .
4. NCER should increase its efforts on cross-media, multiple-substance, and life-cycle research.	NCER will increase the number and scope of media intergrated RFAs on an annual basis.	At least 1 integrated RFA per fiscal year.
5. NCER should balance its extramural research portfolio by funding some social science, cognitive science, and engineering research.	NCER is in process of reorganizing its Engineering and Technology Division as part of a Center-wide re-organization.	Divisonal Research Agenda will be in place by September 30, 2009.
6. NCER should consider using an unsolicited grant submission process to encourage the generation of relevant scientific questions that do not match the exact wording of existing Requests for Applications (RFAs).	EPA policy currently discourages this activity.	NCER will comply with current policy until it is changed/modified.
7. NCER should use the "grant summaries" and "state-of-the-science papers" to begin a dialogue about important gaps in decision-relevant	NCER will communicate research findings internal and external to the Agency.	Communication Strategy will be finalized by June 30, 2009. NCER will meet with Agency Division Directors

Recommendation	NCER Action	TimeLine for Action
information with EPA decision-makers and external scientists.		and National Program Directors biannually.
8. NCER should seek input on possible emerging areas of science from a broader community of stakeholders, not simply from funded scientists.	NCER will continue to work with a variety of stakeholders to maintain a robust research agenda.	NCER will host at least 1 scientific workshop annually. Part of Communications Strategy.
9. NCER should revitalize the Exploratory Grant mechanism and expand it considerably from its current sole focus on nanotechnology.	NCER is considering re-establishing an exploratory research program.	Internal workgroup will develop "path forward" framework by June 30, 2009.
10. NCER should expand the use of bibliometrics to analyze citations to identify audiences and estimate the use of research results by other scientists.	NCER will investigate advanced bibliometric analyses and search engine tools.	Activities will occur on an annual basis.
11. NCER should expand the use of data-mining tools to connect research with immediate and outcomes.	NCER will investigate historical tracking tools to gauge use and impact of ORD research results.	NCER will complete a historical tracking exercise of key research products by March 31, 2009. NCER will conduct a Voice of the Customer (VOC) project using the tracking results by September 30, 2009.
12. NCER should develop case studies of how research funded by the Center facilitates change in tangible indicators of environmental performance ("results"), in addition to how the research is cited, read, and otherwise increases knowledge.	NCER has begun internal discussions to develop template for summary analysis documents which interpret NCER/ORD research results. ORD/NCER will develop case studies and synthesis documents for ORD/NCER's research programs.	NCER will finalize summary analysis document template by January 31, 2009. NCER will produce a synthesis analysis document of results funded within the Ecological research program by June 30, 2009.

Recommendation	NCER Action	TimeLine for Action
		NCER will produce at least 1 data analysis/synthesis-type document on a biennial basis.
13. NCER should consider the implementation of user/client interviews to collect impact feedback.	NCER/ORD will continue to solicit feedback from its Agency partners via surveys of its research programs.	Surveys will be distributed to ORD research partners on a biennial basis Part of Communications Strategy.
14. NCER should consider the use of expert reviews to assess broad scientific impact and program success.	NCER/ORD will continue to seek input and advice on its research activities via external reviews.	The Fellowships Program will be externally reviewed by NCER's standing subcommittee during the 2009 BOSC review.
15. NCER should consider implementation of cost-benefit analyses to measure return on investment.	NCER will complete a Return on Investment (ROI) analysis of the Center's research portfolio.	ROI and productivity trends analysis by research program will be completed by October 30, 2008
16. NCER should use a broader approach than currently is used to demonstrate the links between NCER research and other approaches beyond rulemaking.	NCER will begin to analyze the impact of SBIR program on technology market infiltration.	On an Annual basis: NCER will collect patent & associated revenue from SBIR funded technologies.