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September 22, 2009

Mr. Lek Kadeli
Acting Assistant Administrator
Office of Research and Development
U.S. Environmental Protection Agency
Washington, DC 20460

Dear Mr. Kadeli:

The National Center for Environmental Research Standing Subcommittee (NCERSS) comprising Martin Philbert (Chair), Dennis Clifford, Adam Finkel, Alan Hansen, Sallie Keller-McNulty, David Rejeski, and Seth Tuler convened to discuss the following issue and answer a two-part charge (supplied and highlighted hereinafter). The components of the charge were developed by NCER and were considered by the NCERSS on two teleconferences (January 12, 2009 and April 16, 2009) and one face-to-face meeting with members of the NCER organization in Washington, DC (February 2-3, 2009). At the face-to-face meeting, NCER staff provided information and data on programs pertinent to the charge and remained available throughout the day to provide additional information and clarifications as needed.

Based on the materials provided prior to the face-to-face meeting and discussions held at the February 2009 meeting, the BOSC recommends the following:

1. NCER should perform a needs assessment of the pipeline for undergraduate and graduate students in the environmental sciences and the environmental health sciences. This needs assessment should involve academics, environmental and health science professionals and other stakeholders who could provide data on admission trends, professional opportunities, and other pertinent information that would inform decisions pertaining to deployment of resources in undergraduate and/or graduate training programs.
2. Without being prescriptive, the BOSC recommends the allocation of approximately 10 to 12 percent of NCER's total budget for science policy and emerging issues research. Such an allocation would align with historical investments in exploratory research. The BOSC stresses the importance of isolating resources for *emerging issues* from support for the core research.

The following preamble and charge is a recitation of the elements of the charge.

Preamble to Charge 1: In NCER's last review, the BOSC recommended that NCER seek input from external review panels to identify emerging areas of research. NCER senior management proposes the BOSC Executive Committee (which includes most of the Subcommittee chairs) serve as one of the external review panels to identify emerging research areas. The BOSC Executive Committee is very familiar with ORD research activities and would provide valuable insight to this effort.

Charge 1: *What are the Subcommittee's thoughts on this proposal? In addition, can the Subcommittee provide a potential methodology for prioritizing emerging research areas and a process by which the highest priority research areas are incorporated into the Center's existing research portfolio?*

This charge question grew out of a previous BOSC report focused on improving NCER's ability to engage the external scientific community to craft a more forward-looking research portfolio. The BOSC provided specific recommendations in a March 26, 2008, letter report to the Assistant Administrator for the Office of Research and Development (ORD).

Based on discussions at the February 2-3, 2009 NCERSS meeting, it appeared that the previous letter report, which had provided specific advice on identifying emerging issues and processes for setting priorities, was not useful nor had it been applied by NCER. Consequently, the Subcommittee revisited the issue of external advice, exploratory research, and the research prioritization process.

The Subcommittee supports the idea of using the BOSC Executive Committee as one method to identify emerging research areas and can work with NCER to facilitate this process. The BOSC members believe, however, that NCER needs to dramatically increase the level of structured and actionable external input into the research planning process beyond the use of EPA advisory committees and venues that presently are in place and mentioned in EPA's response to the BOSC's March 2008 letter report. For instance, having EPA scientists attend external stakeholder meetings will not necessarily lead to effective prioritization of the NCER research portfolio. Scientists will bring back information, not systematic priorities.

More broadly, NCER needs to:

- ✧ Develop and continually improve methods for prioritizing existing research.
- ✧ Identify emerging areas that might be missing from the existing research portfolio.
- ✧ Experiment with methods to tap stakeholder knowledge in an innovative manner to both solve existing problems and identify new issues.

These functions need to be ongoing and integrated into the research portfolio rather than be seen as an add-on activity requiring occasional external advice or input or left to informal interactions between scientists.

The BOSC's general recommendation is for NCER to manage a deliberately diversified research portfolio that integrates core research with two distinct areas: (1) targeted research to continually improve priority setting (research to improve research) and (2) research focused on identifying and addressing emerging challenges.

A portfolio approach implies the identification of areas requiring investment and disinvestment, the identification of existing research with low or declining returns, and the assessment of the possible future returns on investments. The three broad areas of the portfolio are described below.

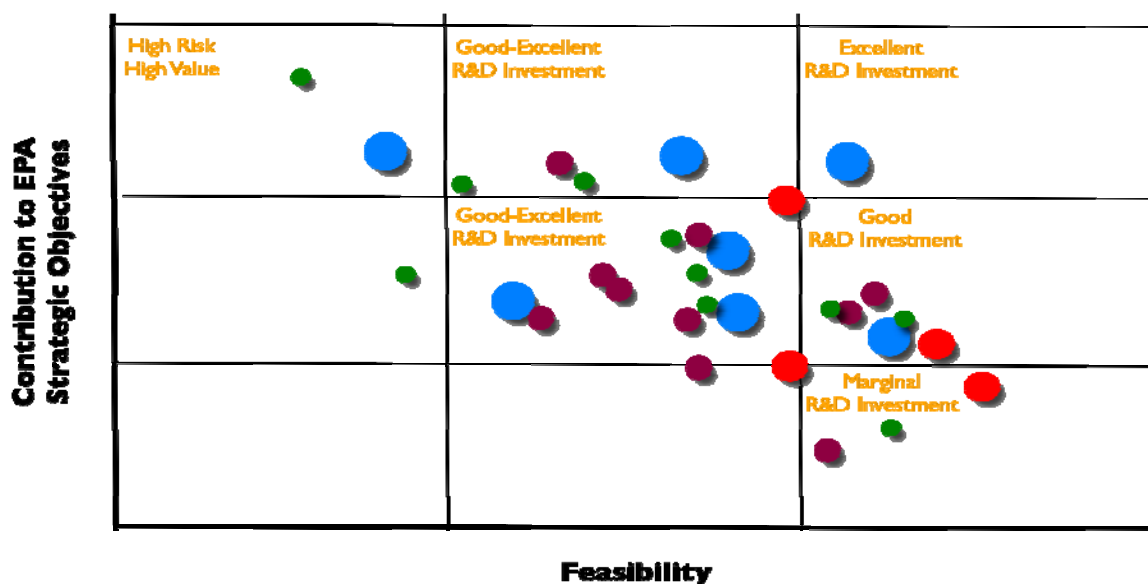
Core Research

A significant portion of NCER's funding would be focused on research tied directly to EPA program needs. These investments would be based on discussions with EPA program offices, but also informed by larger sets of goals set by the Federal Government. Traditionally, NCER has struggled to prioritize a set of priorities that has been handed to the Center by the program offices and clearly needs mechanisms to set these priorities across the core research portfolio. This has to include strategies to identify areas for disinvestment.

In the 2008 letter report, the BOSC outlined an approach that would allow NCER to more efficiently allocate funding across program office priorities by asking WHY each priority (and each second-tier and below item, for that matter) is important or less important to the program offices. "Important" can be evaluated in terms of criteria related to reductions in error, uncertainty, and/or costs of a particular decision that the program offices are required to make. This approach requires the programs to think harder, and be forthcoming about, the nexus between the problems they are concerned about (risks, costs, exposures, etc.) and the decisions they will have to make among ways to address those problems. Without this information, NCER's task becomes more difficult but not intractable.

It is important to stress that the challenge NCER faces is not unique. It is faced by many organizations that have to balance capital with opportunity, which includes a wide range of firms engaged in applied R&D. This means that there are many opportunities to learn from and "benchmark" other organizations with similar prioritization challenges, and a rich and diverse literature that can be drawn upon to help the Center develop better priority setting methodologies. The scatter plot on the next page is one possible way of analyzing the research portfolio of the Center in terms of its contribution to EPA's strategic objectives, which would require some first-order estimates of research relevance.¹

¹ Adapted from: Walker JT, Parmentola JA. 2004. Ten Best Practices in R&D Portfolio Management. *R&D Executive*, November. Available at: http://www.navigantconsulting.com/downloads/knowledge_center/RDExecArticleDec2004.pdf.



Science Policy Research (Research to Support Research)

Given the challenge and importance of being able to set research priorities, NCER should allocate funds to this task. Similar to the new National Science Foundation (NSF) program on the Science of Science and Innovation Policy,² investments would be designed to improve NCER's ability to conduct research, i.e., to carry out its mission in the most cost-effective manner and support policy decisions within EPA. Results from this portfolio would be applied to shaping the core research program as well as prioritizing emerging areas or developing and rationalizing disinvestment strategies. Research would focus on areas such as application of Value-of-Information Theory,³ portfolio management, comparative risk analysis, and the development of new metrics.⁴ Metrics developed under this research program could have wide utility, for instance, for evaluation and reporting under the Government Performance Results Act (GPRA) and Program Assessment Rating Tool (PART) processes.

Emerging Issues Research

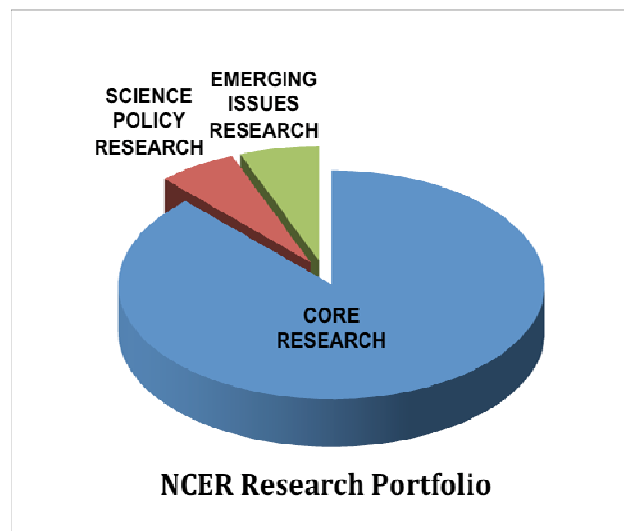
This section of the portfolio would focus on the development and application of innovative methods to improve the "discovery" process for new issues. Areas to be explored might include

² The Science of Science & Innovation Policy (SciSIP) program supports research designed to advance the scientific basis of science and innovation policy.

³ See, for instance, Grinnelly L, et al. Using value of information analysis to inform publically funded research. *Applied Health Economics and Health Policy* 2005;4(1):37-46 <http://ideas.repec.org/a/wkh/ahp/v4y2005i1p37-46.html>, and Yokota F, Thompson KM. Value of information analysis in environmental health risk management decisions: past, present, and future. *Risk Analysis* 2004;24(3):635-650.

⁴ Hubbard DW. *How to Measure Anything: Finding the Value of Intangibles in Business*, New York: John Wiley, 2007.

open-source innovation models,⁵ prediction markets,⁶ expert panels, prizes,⁷ and “sandpits.”⁸ Many of these approaches significantly broaden the search for new and innovative ideas, reaching far beyond the normal Request for Applications used by the Center. Other research agencies, such as NSF, National Aeronautics and Space Agency (NASA), and the Department of Defense (DoD), are actively exploring new ways to identify and solve “frontier” problems. Finally, it is important for NCER to develop clear criteria to allow the Center to shift projects from the “emerging” to “core” sections of the research portfolio (which should have happened in the case of nanotechnology).



The BOSC does not want to recommend an exact allocation of funding to these three areas but the members believe that 10-12 percent of the total budget would be a reasonable set-aside for the areas of science policy and emerging issues research. Historically, NCER invested close to 10 percent of its budget in exploratory research. Much of this funding has been tied to nanotechnology research for the past few years. Nanotechnology, however, is no longer an “emerging” area and efforts need to be made to shift new funds back into the exploratory mode. The BOSC stresses the importance of isolating these areas from the core research program so that they receive adequate attention and support over a longer period of time.

Broadening the Prioritization Process

NCER also should continually examine the alignment of its research priorities with those of other stakeholders, both domestically and internationally. Significant investments are made every year by organizations to prioritize environmental issues and research needs, and NCER can piggyback off of these efforts. Relevant information would include the priorities of the present administration and other federal agencies, but also priorities set by similar agencies in other countries, trade associations, the insurance sector, international institutions (e.g., World Bank, United Nations, and International Monetary Fund), business groups such as the World Business

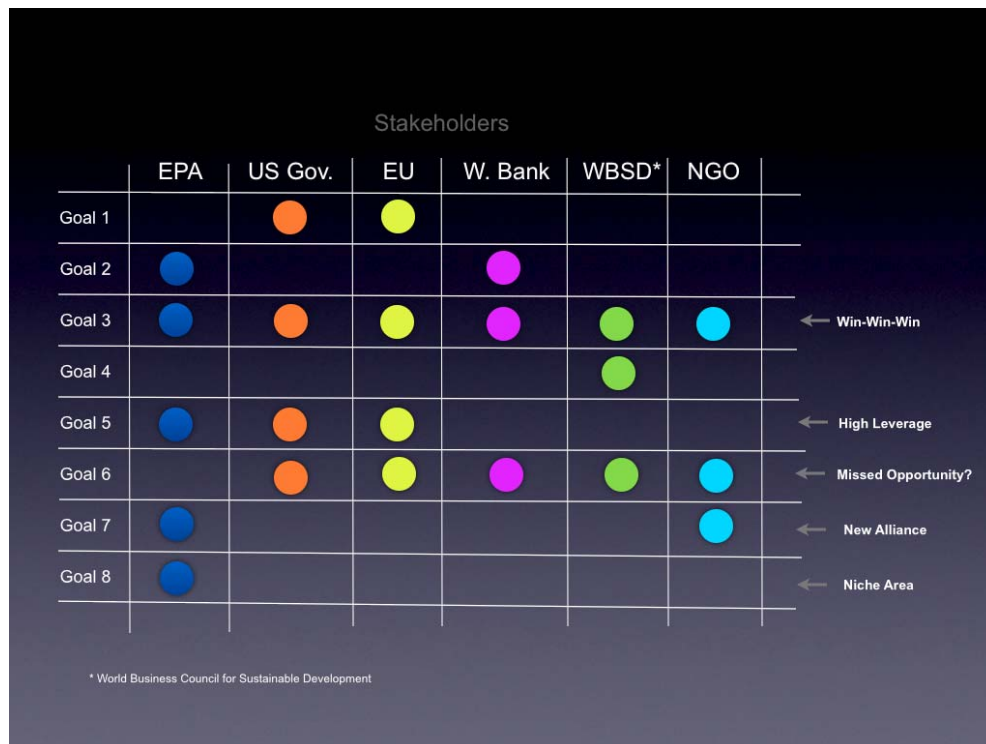
⁵ Huston L, Sakkab N. Connect and develop: inside Procter & Gamble’s new model for innovation. *Harvard Business Review*, March 2006.

⁶ Huberman B, Chen K, Fine L. Forecasting uncertain events with small groups. In: Proceedings of the 3rd ACM Conference on E.Commerce, 2001.

⁷ Kalil T. Prizes for Technological Innovation. Brookings Institute, Discussion Paper, 2006. <http://www1.hamiltonproject.org/views/papers/200612kalil.htm>

⁸ Recently NSF and the United Kingdom Engineering and Physical Sciences Research Center ran a “sandpit” to identify grand challenge topics in synthetic biology. A “sandpit” is defined as an intensive interactive 5-day workshop during which 20-30 people, selected through an open call for participants, develop research projects to address a grand challenge question (see: <http://www.nsf.gov/pubs/2009/nsf09012/nsf09012.jsp>).

Council for Sustainable Development or World Economic Forum, and non-governmental organizations (NGOs). This exercise would include analyzing where opportunities exist to leverage research funding, forge new alliances, or fill critical research gaps (see example matrix below).



The following preamble and charge is a recitation of the elements of the charge.

Preamble to Charge 2: “NCER’s academic fellowships programs are being restructured to provide more opportunities for highly motivated undergraduate students potentially interested in environmental science and engineering issues and areas of research. While the STAR graduate program remains a viable avenue of support for graduate students who want to perform environmentally related research, a strategic decision has been made to realign our somewhat limited resources to focus more on the undergraduate student community. In theory, earlier intervention and exposure to environmental issues and research at the undergraduate level is more likely to influence advanced research and careers in the area of environmental protection, and generally increase the knowledge base within society at large, which may result in improved environmental policies and practices.

Charge 2: *NCER is seeking comments on this directional change, as well as advice from the BOSC on the development of metrics to assess the future impact(s) of the realigned fellowships programs. Any suggestions of how these metrics could be applicable to similar programs (e.g., ORD post-Doctoral program, etc.) would also be helpful.”*

Background

NCER currently supports two fellowship Programs—the Science To Achieve Results (STAR) and Greater Research Opportunities (GRO). These fellowships are awarded directly to students rather than to institutions. The STAR program funds graduate student research while, as of fall 2008, GRO funds only undergraduate students, and contrary to the title, research is not required. For 2009, GRO fellowships provide up to \$19,250 per year of academic support and \$8,000 for internship support for a combined total of up to \$46,500 over the 2-year life of the fellowship. Typically, 10-15 new GRO awards have been awarded annually, but this will increase to 20 new awards in 2009. The fiscal year 2009 budget for the GRO program including new awards, continuing awards, and administration is approximately \$2 million. The GRO program, which originally awarded graduate and undergraduate fellowships, evolved from the Minority Academic Institution (MAI) Fellowships program, which ended in 2003 when it was determined that competition for awards could not legally be limited to minority academic institutions. In 2006, the BOSC recommended that NCER “consider eliminating both GRO Fellowship programs [graduate and undergraduate], while at the same time improving marketing of the STAR Fellowship program to minority-serving institutions to encourage applications for graduate support from underrepresented groups”. EPA’s response was to eliminate the GRO graduate program but to continue to award undergraduate GRO Fellowships. Currently, the goals of the GRO program as published on the EPA Website are as follows:

“The GRO Undergraduate Fellowship program is part of the national effort to help ensure that the United States meets its current and projected human resource needs in the environmental science, engineering, and policy fields (Jackson, 2002). The goals of the program are to bolster the environmental generation of tomorrow, bridge to diverse communities, and boost excellent research and development that advance the protection of human health and the environment through education. The program focuses its efforts at stimulating and supporting interest in environmentally related research and development at institutions of higher education that receive limited federal funding, including in particular institutions with substantial minority enrollment (Environmental Career Organizations, 2001). By enhancing and supporting quality environmental education for undergraduate students, the GRO Undergraduate Fellowship thereby encourages promising students to pursue careers in environmentally related fields and to continue their education beyond the baccalaureate level.”
http://es.epa.gov/ncer/rfa/2009/2009_gro_undergrad.html#Synopsis

NCER Standing Subcommittee Response

After extensive discussion of issues related to GRO and MAI fellowships, it was clear that the Subcommittee generally agreed with the re-alignment of GRO funds to undergraduate as opposed to graduate education. The Subcommittee members believe, however, that to influence careers in environmental science and engineering, EPA needs to reach more students as soon as possible. An expanded outreach is suggested, and should include revising, modernizing, and transitioning the mandatory online Web pages for STAR and GRO fellows to something with the

look and feel of Facebook, Twitter, and YouTube pages, which the BOSC believes would have more appeal to students.

The Subcommittee also made the following observations.

There is a genuine concern, if not a crisis, in student awareness and interest in environmental careers. *More EPA outreach to undergraduate and even K-12 students may be necessary to achieve program's goal to influence careers in environmental science and engineering.*

The amount of GRO (and MAI) funds expended to attract undergraduate students to the environmental field appears to be high for the few alumni who actually entered graduate school or were employed in the environmental field. Rethinking (a) how these limited funds are to be spent, (b) how to tap into student passion for the environment, and (c) the ways in which success is measured is required. To aid this "rethinking," the Subcommittee suggested that interested, passionate, undergraduate students, including GRO fellows/interns, be assembled into a number of focus groups (10-15 students/group) that would discuss and report on how to use modern means of communication to increase student knowledge of environmental issues and careers. One mechanism to fund these focus groups, and possibly other creative measures, would be through a competitive grant process based on a carefully written RFA to address these issues. These new grant(s) could be included in a call for GRO Consortia proposals as described below. (Italics supplied for emphasis.)

Some Subcommittee members thought that even limited consortia funding would have merit in better targeting GRO funds to underrepresented students because the students would receive better faculty mentoring. This could include funding two consortia proposals of \$500K each, pairing tier 1/lower tier universities in each consortium, leaving \$1 million remaining to fund individual GRO fellows.

It was generally agreed that awarding GRO funds to a few consortia of universities would likely reduce the number of students funded because of consortium administrative costs and narrow the geographic breadth of the awards. NCER also could possibly face challenges in getting qualified environmental faculty support because of the modest level of funding. This would depend, however, on the details of the submitted proposals. It also was pointed out that, if the goal is to expose students to environment-related studies, the number of students funded may be more important than quality mentoring of fewer students. (Italics supplied for emphasis.)

NCER should consider using measures of success other than the number of alumni securing environmental jobs and entering environmental graduate programs. Just producing environmental awareness in graduates could, in the long run, improve the environment. In this regard, the Center needs to make sure that GRO fellows take a sufficient number of environmental courses and that other science and engineering majors are encouraged to take appropriate environmental elective courses. One possible metric of success would be the number of students, particularly underrepresented minority students, who complete an environment-related degree program in any given year.

In addition to targeting underrepresented minorities in the GRO funding process, GRO fellows should be involved in “Integrated Interdisciplinary Research,” research related to sustainability, and research in emerging areas.

In summation, the BOSC commends NCER for its willingness to engage the BOSC Executive Committee in identifying new and fruitful avenues for extramural research that hold the promise of supporting Agency needs. The BOSC urges NCER to employ innovative approaches to obtain input from a broad spectrum of interested and expert stakeholders. Similarly, NCER will need to use available and emerging tools for engaging communities of currently funded students and alumni. It is anticipated that use of these powerful approaches will aid in addressing many of the issues laid out in the charge to the NCERSS.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Gary Sayler', with a long horizontal flourish extending to the right.

Gary S. Sayler, Ph.D.
Chair, BOSC Executive Committee

**Attachment:
Members of the NCER Standing Subcommittee**

Martin Philbert, Ph.D., Subcommittee Chair

University of Michigan

David B. Baker, Ph.D.

Heidelberg College

Dennis Clifford, Ph.D.

University of Houston

Adam Finkel, Ph.D.

Princeton University

D. Alan Hansen, Ph.D.

Sallie Keller-McNulty, Ph.D.

Rice University

David Rejeski

Woodrow Wilson International Center for Scholars

Seth Tuler, Ph.D.

Social and Environmental Research Institute, Inc.