

Committee of Visitors Charge to BERAC

On October 23, 2013, Dr. Patricia Dehmer, Acting Director, Office of Science, charged the Biological and Environmental Research Advisory Committee (BERAC) with assembling a Committee of Visitors (COV) to assess the processes used to create and manage the research portfolio in the Biological Systems Sciences Division (BSSD) of the Office of Biological and Environmental Research (BER).

In response to this charge, a COV was established consisting of 16 scientists from around the country, with representation from academia (13), industry (1), and other federal agencies (2). Six of the COV members currently receive DOE funding. None of the COV members served on the prior BSSD COV that met in 13 – 15 June 2011. The COV met on 9-11 July 2014, at the DOE headquarters in Germantown, Maryland. Assistance and support were provided, as needed, by the BSSD staff.

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Elements of the 2014 COV Review

To maximize the effectiveness of the analysis, 3 subcommittees of the COV were formed – each assigned to review carefully and deeply a different Program or Project of the overall BSSD research portfolio. The entire COV evaluated and analyzed the portfolio, as a whole, and provided comments and recommendations.

The COV was specifically asked to examine the processes BSSD used to solicit, review, recommend and document application and proposal actions, and how BSSD monitors active awards, projects and programs. Moreover, the COV was asked to comment, within the boundaries defined by DOE mission and available funding, on how the award process has affected the breadth and depth of the portfolio elements and the national and international standing of the portfolio elements.

The COV reviewed five elements of the BSSD science portfolio that were active since the prior COV review:

1. Two Facilities (JGI and Structural Biology Facilities)
2. Four Laboratory Science Focus (SFA) Program Areas comprising 18 individual SFAs: 1) Ethical, Legal, and Societal Issues; 2) Genomic Science (Knowledgebase, Biofuels, Foundational); 3) Low-Dose Radiation, and 4) Radiochemistry.
3. Six University Funding Opportunity Announcements (Genomic Science Program, Plant Feedstocks, Radiochemistry and Instrumentation)
4. Three Bioenergy Research Centers (BRCs)
5. The Artificial Retina Project (AR), completed in 2011.

Division-wide observations

The COV was impressed with the overall quality and management of the solicitation of proposals and the review process. Although the PMs are currently short-staffed, the COV commends their role in implementing what we perceive to be a fair and equitable review process that uses the highest standards of the competitive funding community to maintain a vigorous research portfolio.

The funded programs have a good balance of risky, solid, and innovative science.

No serious concerns were raised by the COV concerning consistency with priorities and criteria stated in the program's solicitations, announcements, and guidelines. However, we have made a few suggestions in our review of different programmatic areas regarding the importance of preparing very focused FOAs, in order to alleviate possible investigator confusion about FOA scope at the preproposal or full proposal stages of response. This would also assist the reviewers.

Division-wide observations

Merit reviews were uniformly conducted with an adequate number of highly qualified reviewers, without obvious conflicts and having appropriate expertise that together provided appropriate panel breadth.

In most instances, the time between issuing the FOA, submission and decision of preproposals and proposals was satisfactory, providing investigators ample time for preparation. There was generally good documentation of the proposal review and evaluation process.

However, the COV noted in a limited number of cases sparse documentation supporting the recommendation for funding or declination of submitted proposals. The COV did not feel these awards were inappropriate, just that the documentation for the justification of the award was absent from the files.

Division-wide observations

Staff Transitions and Travel Restrictions. There are serious effects of anticipated retirements and recent departures of program staff on programs. Limited staff will increase the difficulties of running programs and, if not rectified, affect program quality.

Greater flexibility and support for PM site visits and participation in contractor meetings is also essential for stimulating interactions among the variously funded research programs.

Recommendations: There is an urgent need to develop and implement a plan to hire additional staff. There is also a need to provide greater flexibility and budget support for PM and staff attendance at scientific meetings, site visits, and contractor reviews. This is essential to insure that Program Officers optimally manage their projects by keeping up to date on scientific advances and have the opportunity to interact more directly with investigators.

Division-wide observations

The COV review process. Significant time was lost during the COV review because of documentation that varied in organization and depth. The committee recognizes that current staff shortages and heavy PM and staff workloads may also have impact the COV review process.

As also noted by the previous COV, it would also be very helpful to provide the COV with this information prior to the meeting of the COV. Documents provided could be organized according to working groups (folder for Working Groups), including the summaries needed for working group discussions.

Recommendation: Provide greater background information relating to FOA and SFA development, integration, and prioritization.

This would include a cover document with a table of contents and summarize project personnel and collaborations. For SFAs, include an outline of the chronology of each SFA providing times of review and outcomes, and the reasons for the decisions regarding funding/termination. Also, to better assess the quality/impact of the funded efforts, it would also be very useful if appropriate program-level metrics (e.g., publications, # students/postdocs trained, significant recognition of PI's such as election to NAS/NAE) could be provided to the COV.

Recommendation: Electronic records, when developed, should be designed to facilitate the COV review and record keeping of this process.

Division-wide observations

BSSD Program Administration

Given the diverse portfolio of research areas supported by this Division, this is a remarkably lean operation. In addition to the Division Director, the current staffing includes 9 PMs, one AAAS Fellow, and 2 support staff. Several PMs have exclusive responsibility for essential programs. As some PMs move toward retirement, it will be critical to develop a plan for transition to new leadership. The current staffing shortage will be partly alleviated by a search for a new computational biologist PM and anticipated solicitations and hires of two new PMs and a science assistant. However, the COV thinks this remains minimal staffing in consideration of the very considerable PM and staff workloads.

The COV was impressed with the rigor of the FOA solicitation, review, and monitoring activities by the PMs, especially considering the limited funding for the FOAs and for support staff to administer the FOAs.

The **COV recommends** more clarification in FOA solicitations such that the topic is more focused, with the intent to direct submissions more in-line with the DOE mission and FOA topic area.

The **COV also recommends** that the pre-proposal process be more selective and that a smaller number of pre-proposals be advanced to a full submission. This would serve several purposes: reducing the effort of PIs in preparing proposals that will not likely be funded, reducing the workload of the reviewers, and permitting more discussion by the review panel on which proposals should be funded.

Division-wide observations

PM Travel Restrictions

In addition, a major concern of this COV, as well as the previous COV, is the ability of PMs to adequately engage the scientific community. Attending meetings, and discussions with investigators in the field, are essential for science managers to stay ahead of the "state of the art" in any given arena.

This seems particularly critical for the KBase program, a nascent program that would benefit tremendously from more frequent direct interactions with the PM. Over the whole of BER, \$600M/yr in research funds may be jeopardized by the lack of a few thousand dollars in travel funds to allow program officers and reviewers to travel to contractor sites and ensure that spending, progress and direction are on track and appropriate.

In spite of the current staffing and travel challenges, we note that the administration of BSSD programs remains a first class operation. The BSSD research portfolios are at the cutting edge of a diverse array of research questions that are critically important to national needs.

Facilities: Joint Genome Institute (JGI)

The COV reviewed the user programs maintained by the DOE JGI listed as follows:

- Community Science (formerly Sequence) Program, (CSP)
- Emerging Technologies Opportunity Program (ETOP)
- JGI EMSL Collaborative Science Program
- DNA Synthesis Program
- Bioenergy Research Center (BRC) Science Program

The COV commends the PM and JGI for its overall commitment to undertaking significant scientific and technological accomplishments and for continuing on a path to expand these capabilities since the previous COV, and accomplishing this despite the dynamic funding and administrative climate within which these efforts have taken place.

Facilities: Joint Genome Institute (JGI)

Community Science Program

Of the community user programs maintained by the JGI, the longest standing program is the CSP, established in 2004. Currently 50% of the JGI sequencing capacity is dedicated to this program. The COV agrees that the overall review process is efficacious, reviewers are being drawn from sources outside of the JGI, and the quality of the reviewers is typically strong.

The Project Manager is well versed in all of the JGI projects and remains actively involved in supporting further developments. As long as the PM continues to lead the facility, the COV feels that there is excellent stewardship. However, continued effective stewardship will require appropriate travel support to meet with scientists within and outside the JGI.

The COV also appreciates the CSP's changing emphasis from a largely sequence generator of model organisms (e.g., single microbe) to undertaking more complex projects (e.g., microbial communities), and an increasing focus on the ability to analyze and interpret the sequence data generated.

New Initiatives: Joint Genome Institute (JGI)

New JGI Initiatives represent important steps forward for the JGI.

- The Emerging Technologies Opportunity Program (ETOP)
- JGI-EMSL Collaborative Science Program
- DNA Synthesis Program

New Initiatives: Joint Genome Institute (JGI)

Emerging Technologies Opportunity Program

The ETOP has only recently (2012) been undertaken to identify new strategic partners and unique scientific capabilities in areas such as high throughput functional genomics, microfluidic enabled molecular biology, and DNA synthesis technology. Six project were awarded in mid 2013 from 9 full proposals solicited by the JGI Management team (out of 69 LOIs received).

JGI-EMSL Collaborative Science Initiative

First call for LOIs was in 2013, with full proposal review (27 submitted) by a JGI/EMSL management team. The COV appreciates the importance of this program as a new initiative to increase the relevance of each of these DOE supported facilities and that further; this is a significant opportunity to facilitate new approaches to answer questions in the biological sciences relevant to DOE missions.

The DNA synthesis program

The DNA synthesis program represents another initiative by the JGI to transition from largely a sequence facility into new areas of genome-based science. Synthetic biology and biological engineering represent new frontiers in microbiology and the COV appreciates the JGI's recognition of this fact and efforts in this area. However, this is also a technology area that is being rapidly developed in other commercial, private, and public sectors

New Initiatives: Joint Genome Institute (JGI)

The COV recognizes that these new programs may need to have a period of internal review process to learn how best to continue to formalize the program. The COV is supportive of these new initiatives, but the ultimate impact on JGI advancement and relevance are still to be determined.

Care will need to be taken in the future to better focus these programs, which can be achieved in part by developing more robust proposal solicitation and peer review mechanisms, along with soliciting input on overall program relevance from the wider scientific community.

Recommendation: *COV recommends that the review process for the new initiatives (ETP, JGI-EMSL, DNA Synthesis) be developed into a robust peer review process that reaches out and includes outside scientific expertise. Due to the rapid pace of change in sequencing technology, the COV recommends that this review should include regular documented evaluation addressing specifically whether the facility is the best use of program resources.*

A continued and expanded effort should be made to advertise the presence, purpose and results of these programs to the wider scientific community to encourage both a greater pool of researchers to be engaged in the use of these facilities in their research, and in the peer review process. This is critical to developing the JGI as a true user facility.

JGI support of Bioenergy Research Centers

Sequencing support of Bioenergy Research Centers

The BRCs receives ~30% of the JGI sequencing capacity and this includes the completion of large plant genomes (e.g., of switchgrass, *Panicum virgatum*) that the COV notes are not simple genomes that could be easily completed at a typical university core facility. The COV in general recognized that the JGI is providing an appropriate contribution to this effort.

However, the **COV recommends** that the *impact of this work continue to be carefully balanced against the needs of smaller projects and users outside of the BRCs*.

JGI: General observations and recommendations

While the COV recognizes the basic success of the JGI sequencing facility, the ability to review this in detail is difficult to complete as most summary information is related to number of base pairs generated, users statistics, and number of operating hours. **It would be helpful** to have more user information made available to future COVs, to better track and evaluate facility impact within the scientific community and competitiveness with other large-scale facilities.

The existing Scientific Review Board for the JGI serves JGI well, but is charged by JGI management, and not directly responsible to DOE.

The COV recommends that JGI continue to evaluate the core sequencing services they provide against the continuing rise in sequence capacity at many institutions (e.g., University Core Facilities) and the impact this may have on future emphasis of DOE resources in this area. The COV notes that adjusting this program accordingly is critical to generating a program that is truly responsive as a user facility supportive of community research. An external advisory process could periodically consider this question.

JGI: General observations and recommendations

The KBase PMs have clearly made significant efforts to encourage collaboration between the KBase group and JGI, which has been working on related tools for some time. However, this appears to be embraced only reluctantly by both sides. JGI was not able to submit a proposal to the KBase SFA solicitation, since only one proposal from LBNL was allowed. In the future, the mission may be better served by allowing individual labs to submit multiple proposals (for instance, LBNL has multiple capable units).

Recommendations: *The COV recommends that the continued development of analytical capabilities should not occur in a vacuum (i.e., within house) and that in particular the overlap with the development of KBase as an analytical resource needs to be conducted and monitored carefully and in a strategic manner so as to leverage JGI and KBase resources in the most efficient manner.*

Recommendation: *Establish a formal mechanism to insure that KBase and JGI collaborate productively and avoid duplication with ongoing computational biology efforts (both within and outside DOE).*

The COV notes that the evolution of JGI in response to the changing analytical and computational landscape will require appropriate travel support for the PM to meet with scientists within and outside the JGI.

Facilities: Structural Biology Facility Access Program

The BSSD support enables access to National User Facilities by a broad community of biologists, chemists, and environmental scientists.

The Structural Biology and related facilities programs supported by BSSD include programs at:

- Argonne National Laboratory - supporting structural biology
- Brookhaven National Laboratory - supporting structural biology on several beam lines
- Cornell University - x-ray sensitive detectors for biological and organic materials (ended in FY2011)
- Lawrence Berkeley National Laboratory - x-ray spectroscopy of biological and environmentally important materials, infrared and x-ray microscopy, and for x-ray diffraction of protein crystals and scattering from macromolecules in solution
- Oak Ridge National Laboratory - structural molecular biology and the BioSANS station at the High Flux Isotope Reactor
- Los Alamos - supporting the neutron Protein Crystallography Station
- Stanford Linear Accelerator Center National Laboratory (SLAC) - supporting structural biology
- BSSD co-funds the Protein Data Bank at Rutgers University.

Structural Biology Facilities – General recommendations

The research community benefits enormously from the structural biology facilities supported by the DOE. The PM is well versed in all of these projects and remains actively involved in supporting further developments of XFEL, synchrotron radiation, and neutron scattering facilities. The qualities of the chosen referees and their written reviews are excellent. The COV members have no concerns regarding the appropriateness of the reviews or program management.

Recommendations: *The COV emphatically encourages the continued co-funding of these facilities with NIH and other agencies. Continued support of the Protein Data Bank is essential given that this data bank influences a wide range of bioenergy research from enzymology to cell biology, nationally and internationally.*

Structural Biology Facilities – General recommendations

The COV was concerned with the lack of substantial funding set aside for capital equipment. This prevents long term planning of new beamline facilities or major upgrades. For example, an upgrade of the SBC sector at Argonne Advanced Photon Source (APS) will be required in conjunction with the overall APS upgrade scheduled in ca. 2019. This is critical for SBC to remain internationally competitive.

Recommendation: *The COV recommends that the BSSD put in place a mechanism to prepare for the timely upgrades of BER funded synchrotron and neutron experimental stations.*

Recommendation: *Given uncertainty about the timing of PM retirement, the COV expressed some concern about planning for leadership transition. The COV strongly recommends that the BSSD management prepare a timely succession plan and at the same time establish a panel of experts to help prepare for both a smooth transition of leadership and for the establishment of a road map to guide future facility development and operation.*

Laboratory Science Focus Area (SFA) Programs

The shift from single investigator to Scientific Focus Areas (SFAs) was designed to encourage collaborative, multidisciplinary research within the labs - such collaborative research should result in outcomes that are greater than the sum of the components.

The transition to the SFA funding framework will also enable the National Laboratories to plan future research directions in a coordinated, strategic manner that is responsive to changing research needs and national priorities.

There are currently 18 SFAs funded by BSSD in the National Laboratories distributed among the following general program areas:

1. Ethical, Legal, and Societal Issues (ELSI)
2. Genomic Science (KBase, Biofuels, Foundational)
3. Low-Dose Radiation
4. Radiochemistry

All 18 SFAs were covered in this review: 1 in ELSI, 3 in Low dose radiation, 4 in Radiochemistry, and 10 in Genomic sciences (5 in Foundational, 1 in Systems biology (KBase), and 4 in Biofuels research). With the exception of KBase, the 18 projects reviewed by this COV existed at the time of the last review.

SFA Selection and Management

With the exception of KBase, the process by which topics for SFA's were identified and how teams were invited to apply was not a specific subject of our review.

The committee was supportive of the KBase solicitation and review process and recommends this general process serve as a template for the solicitation of future SFAs. A well-defined and documented system was employed to solicit proposals from the national laboratories, obtain written reviews from high-quality reviewers, conduct reverse site visits, make awards and declinations, and obtain budget revisions. However, the COV was unsure whether the decision to combine a poorly reviewed proposal with a well-reviewed proposal happened during review, panel discussion, or afterwards among PMs and whether there was further outside input. The decision process could be better documented.

PMs are doing an excellent job managing the SFA programs. DOE PMs communicate important project reporting due dates for revisions, budgets and/or annual or final project reporting requirements.

Ethical, Legal, & Societal Issues (ELSI)

Three ELSI projects were funded during the current COV timeframe, 2 to national labs (ORNL and LBNL) and one to the Venter Institute. This SFA will not be renewed for the next triennial and will be replaced with a project at ORNL, which supports goals related to the SC-23 Biosystems Design program.

Review documents and communication among PIs and DOE PMs related to the SFA were very well organized. An organized cover sheet outlined the evolutionary history of the ELSI Program, now focused on upcoming societal challenges related to bioenergy and nanoscience.

Recommendation: *This documentation was extremely useful and similar documentation should be provided for each SFA in future COV reviews.*

The ELSI program has evolved to include social and legal issues related to nanoparticles, bioremediation, bioenergy development, genetically modified crops, synthetic biology, and evacuation policies and public safety risks associated with nuclear incidents. These remain pressing societal issues. Thus, ELSI has the potential to contribute significantly to public education and awareness of the DOE scientific portfolio, and thereby assist in the adoption and support of specific technologies by communities.

Recommendation: *These remain pressing societal issues and the program remains an important component of the SFA portfolio. The COV encourage BSSD to continue support for ELSI as an integrated component of ongoing scientific programs.*

KBase

The grand, ambitious goals of KBase include solving many critical software needs for interdisciplinary genomic science including molecular biology, systems biology, and genomics. It is a major effort with a budget over \$12m/y.

This project is scientifically exciting and at the cutting edge of the discipline. This is high risk, high potential impact research, but also has a significant service/outreach component to ensure the methods and tools developed are actually used.

- Given the broad breadth of KBase goals and its diverse audience, it is unclear what mechanisms have been put in place to communicate with possible users, interface with DOE JGI, and/or involve other FOA grants.
- Although the current investigator composition insures this program will deliver high quality science, there are significant challenges to achieving a “one stop” computational resource.

KBase

KBase is a good example of the strengths and weaknesses of the SFA funding structure.

There has clearly been a very significant involvement of program staff to ensure that KBase remained an appropriately mission-oriented project. For example, during the initial reviews, both the reviewers and PM voiced the lack of plant expertise in the LBNL-led proposal, resulting in fusion of the LBNL-led project with the BNL project.

However, given the predominance of plant biology within BER as a whole, the plant portion of KBase still appears to be a poor relation in funding and emphasis relative to the microbial portion, yet is arguably a more challenging problem that will require more resources to solve.

Recommendation: *The balance of plant to microbial emphasis within KBase should be revisited.*

Recommendation: *Going forward, the best mechanism for evaluating tools is to solicit reviews by potential or current users, and the best mechanism to measure impact is to count peer-reviewed publications that cite or acknowledge Kbase.*

Recommendation: *A plan should be put in place to provide necessary computational resources (e.g., flexible cloud compute allocation) for any tools developed under this program that are both successful and computationally intensive. Without these resources, the tools will not be useful within the KBase framework. Such a plan should be focused on resources and infrastructure provision rather than being a focus of the KBase program itself*

Biofuels

This is a major part of the SFA research portfolio, and complements the Bioenergy Research Centers that are managed separately. The scientific quality and breadth of these programs is very impressive. The current SFAs in this program are of appropriate scientific depth, of high overall quality, and well managed.

However, the COV was divided in their opinion of the potential for the various biofuel-related projects to ultimately benefit the nation. Some felt that future promise in this area will primarily be in the generation of starting materials for organic synthesis. Others felt that increased understanding of photosynthetic systems and their potential to contribute to sustainable sources of feedstocks and fuels is essential to moving towards a sustainable economy.

The divided opinion among committee members may reflect the lack of a high level rational for support of the individual projects and the expected synergy among projects.

Foundational Genomic Science

These 5 SFAs (ANL, LANL, ORNL, LBNL, and PNNL) cover varied aspects of microbial ecology. The projects provide new information for understanding organisms, their roles in the environment and for developing tools with implications for carbon cycling, remediation of contaminated sites, and assessing the responses of ecosystems to environmental change. The projects in this portfolio are collaborative, interdisciplinary and use state-of-the-art techniques and novel approaches. These projects are among those leading the field in environmental microbiology research.

All projects were examined by 4 to 6 reviewers. Four of the 5 projects passed the triennial review. There were no rankings found for the Biofuels SFA proposal from PNNL (which was ultimately rejected in review).

It was very difficult to determine the numbers of PIs involved in each project and how the projects related to each other. It was also unclear to the COV whether the summary of the review panel was generated by the PM or the panel. Thus, although the review and management of these SFAs appear to be very good, some lack of detail in documentation (e.g., PI composition and SFA relationships) may leave the program management open to criticism.

Low Dose Radiation Area

The COV examined all three SFA for the years covered in our remit (2011-2013) and extended our review to include active programs for which the most recent full review fell outside 2011-2013 timeframe.

The PM thoroughly documented all procedures involved in the management of this portfolio. The SFA review process is thorough and proceeds at a pace that is commendable, with minimal intervals between application submission, review and funding.

The breadth and expertise of the reviewers are outstanding with coverage of the needed areas of expertise. Progress of awarded SFAs was monitored and documented thoroughly. Site visit reports and e-mail correspondence were included in the files as appropriate.

Low Dose Radiation Area

Program productivity has been high with over 700 peer-reviewed publications in its 15-year history. The Low Dose Program is unique in addressing issues central to potential health effects from environmental, occupational, and accidental as well as low-dose medical exposures to ionizing radiation that are a significant and continued concern of the US public.

Despite the vital importance of the information generated by this program the budget has been reduced from \$21.7M to \$6.2M in the time span covered by this review (2011-2013). The reduction in this portfolio has caused the loss of training and employment opportunities in an area that is critical to public health. **The COV is concerned** that in the absence of new low dose SFA solicitations in this review period will compromise the future of this important program.

Recommendation: *COV recommends exploring the possibility of intra-agency co-funding from other scientific programs (e.g., NASA, NIH, Navy), or possibly international coordination in order to recover momentum and expand efforts in this highly focused research area.*

Recommendation: *New initiatives in the low dose program are essential for retaining the balance between Federal Laboratory and university efforts*

Radiochemistry and Imaging

The goal of the SFAs are to support the DOE mission related activities in bioenergy and bioremediation as well as develop fundamental methodologies that lead to transformational new technologies for medical research.

The four SFAs (BNL, LBNL, ORNL and TJ) are well organized and managed. The review and award process is clear and there is a thorough review process for all proposals (4-7 reviewers per proposal) with consistent high quality reviews.

The PM has each SFA well documented and is in close communication with the PIs. All SFAs are consistent with the DOE mission and focus radiochemistry and instrumentation development towards the understanding of plants and microbes for producing biofuels, cleaning up waste and sequestration of carbon.

SFA Triennial Review Process

The SFAs underwent their first triennial review during the period reviewed by this COV. The triennial reviews were in the form of a progress report/proposal defended during one or half-day reverse site visits. The reviews appeared to have been well managed in all aspects. Given the staff shortages within the BER Program, and limitations in the travel budgets, the detailed interaction with PIs is commendable and additional staff to replace current vacancies will assist future reviews.

Where the peer review members agreed on a concern, annotation was added to make the PI aware of these concerns. None of the concerns noted was considered a 'show stopper', but rather provided the opportunity to improve the expected outcomes of the project.

SFAs – General Observations and Recommendations

Recommendation: A formal, documented and reviewed process for the creation of new SFAs should be created and made available to future COVs for review.

Recommendation: Develop a clear process and documentation of the decision process when redirecting or terminating an existing SFA.

There is naturally some redundancy across and within SFAs funded at National laboratories. For example, the ‘biofuel’ SFAs are not clearly linked (or vice versa) with the Bioenergy Research Center goals. Although the committee endorses the freedom of the individual National Laboratories to conduct independent lines of research within the SFA funding structure, it was not clear to the COV that a mechanism existed to prevent redundancy and promote dialog between related projects.

Recommendation: *We encourage BER management to develop mechanisms to produce ongoing dialog between related SFAs when appropriate, and to request collaboration and synergy between related SFAs. This particularly applies to the (non-BRC) biofuel SFAs and their relationship to the BRCs, and to KBase and JGI.*

Funding Opportunity Announcements (FOAs)

There were seven targeted solicitations to the university community issued as Funding Opportunity Announcements (FOAs)

The Genomic Science Program issued 6 FOAs during this review period

1. Plant Feedstocks for Bioenergy, Joint with USDA (Notice 11-417,12-598, 13-770)
2. Genomic Science and Technology for Energy and the Environment (Notice 10-368)
3. Genomic Science: Biosystems Design to Enable Next Generation Biofuels (Notice 12-640)
4. Systems Biology Enabled Research on the Role of Microbial Communities in Carbon Cycling (Notice 13-866)

Nuclear Medicine issued one FOA

1. Nuclear Medicine Research and Training Grants of Excellence (Notice 12-646)

Genomic Science

Plant Feedstocks for Bioenergy, Joint with USDA

The joint DOE-USDA Plant **Feedstock program** was seen as strategic and a powerful way to leverage funds, interest, and expertise between DOE and USDA - thereby having projects with basic and applied components in a single portfolio.

The COV was particularly impressed with the rigor of the review process for the three Plant Feedstock FOAs and felt that the proposals selected for funding were the most meritorious proposals. The PM was in regular contact with the awardees through e-mail correspondence, annual reports, scientific meetings, and the annual awardees meeting.

Genomic Science Biosystems Design

Development of the three FOAs during this reporting period appears to have been guided by the 2009 GTL Strategic Plan and the Biosystems Design workshop held in 2011.

1. Genomic Science and Technology for Energy and the Environment (10-0368)
2. Genomic Science: Biosystems Design to Enable Next Generation Biofuels (12-0640)
3. Systems Biology Enabled Research on the Role of Microbial Communities in Carbon Cycling (13-0866)

Genomic Science Biosystems Design

The focus of the 3 FOAs is distinct, and the program has evolved over time to address new scientific areas (e.g., wedding systems biology to the study of terrestrial carbon cycling) as well as attracting new investigators to DOE. The program appears to have a balance with respect to breadth, although tradeoffs between breadth and depth may occur when soliciting larger, multidisciplinary, longer duration projects. The success rate for proposals submitted to these FOAs was highly variable, ranging from 9% to 29.4% (average: 14.8%).

Recommendations: It would be useful to articulate a vision to eventually connect/translate the systems biology aspects of the portfolio to the Plant Feedstocks Program portfolio in the future. The selection of only one project each per organism type in the Biosystems Design FOA may not give sufficient depth to cover this field.

Nuclear Medicine

Low Dose Radiation Research Program

There were no FOAs over the 2011-2013 COV period. This was seen as a major weakness.

Radiochemistry and Instrumentation Program

This area has suffered severe cuts in funding during this COV review period. When the overall BSSD budget was reduced, the Radiochemistry/Radiation Science areas seemed to take the brunt of the cuts. Only one FOA (12-646) in Nuclear Medicine was announced during the 2011-2013 time period of this COV, compared to 5 for the previous 3 year COV cycle. It was unclear to the COV whether this reflected the least internal resistance of a small program or intent by the BER/BSSD Director/Associate Director to phase out these programs. Unfortunately, this area is also unique within the Federal funding arenas, and should not be allowed to disappear.

Recommendations. *Retain appropriate level of funding to both universities and national labs as needed to maintain essential training and workforce development in key radiochemistry areas (nuclear medicine and plant/microbe imaging and radiochemistry). Funding of both universities and national laboratories is necessary to provide for interactions and collaborations, as well as offer graduate student and postdoctoral trainees access to facilities and instrumentation in both research environments.*

FOAs – General observations and recommendations

The FOA solicitation process is heavily affected by the budget cycle and the PMs are challenged with respect to timing needed to get the FOA released, pre-proposals reviewed, full proposals solicited and reviewed, and awards recommended by a DOE deadline of July 1st. The PMs are involved in all procedural aspects of the FOAs and resulting funding decisions.

The COV felt that the high number of full proposals for some FOAs (highest 289) required a lot of work by submitters, the review panel, and the PM. The COV felt that some of the FOAs' scientific scope needed to be clearer and explicitly state not only the topics of interest but topics or foci that would not be consistent with the DOE mission and/or the PM's portfolio.

Recommendation: *A more focused solicitation and/or more rigorous screening of pre-applications is advised such that the funding rate is elevated to 20-25%. For example, more narrowly focused FOAs would clearly articulate not only what is sought, but also what is not, would be beneficial (e.g., no "food" plants), and will ensure the correct panel expertise is invoked for each proposal.*

FOAs – General observations and recommendations

The COV was concerned over one “orphan” project (“Microbial Ecology, Proteogenomics, and Computational Optima”, Harvard Medical School) that receives a significant amount of funding per year without substantial review. The level of funding provided to this single project without an open competition was seen as not efficiently serving the BSSD mission.

Unlike the other two FOAs, FOA 13-0866 offered supplemental funds (up to \$300K per year) to develop systems biology and ‘omics data in collaboration with Kbase.

Since the KBase milestones and reports do not reflect a timeframe by which software would be adopted for specific purposes, the COV felt that the inclusion of \$300k targeted funds for collaborations with KBase for one FOA was not especially well thought out.

Bioenergy Research Centers

The U.S. Department of Energy (DOE) established three Bioenergy Research Centers (BRCs) in September 2007 – the Bioenergy Science Center (BESC), Joint BioEnergy Institute (JBEI), and Great Lakes Bioenergy Research Center) - with a second 5-year phase beginning in 2012.

Each center represents an integrative, multidisciplinary partnership with expertise spanning the physical, chemical, biological, and computational sciences, including genomics, microbial and plant biology, analytical chemistry, computational biology and bioinformatics, and engineering.

Oversight of the BRCs appears to be appropriate for the level of investment in these Centers. The BRCs in general showed both strong oversight and strong site-level management producing excellent and well-organized proposals, reports and reviews.

A team of BER/BSSD PMs is responsible for management of the BRCs, with one PM specifically assigned to BRC management. Communication between DOE and the BRC's is facilitated by monthly conference calls with the individual BRC directors and program staff. There are also quarterly conference calls with all three directors and open email communication. External annual reviews of the centers are conducted in the autumn and involve topical experts and program staff.

Bioenergy Research Centers renewals and linkages to biofuel SFAs

On the basis of the ongoing oversight of activities in the BRCs, a decision was made to request renewal proposals from each of the three teams. New applicants for BRCs were not invited and decisions to renew were based on a combined 4th year progress and renewal review of the science and management of each Center conducted at a site visit during late 2012.

The site visit teams consisted of highly regarded experts in the various fields represented in the BRC activities, with between 8 and 12 scientists on each site visit team. The COV judged these reviewers to include experts in relevant areas of science with a broad view of the field, capable of judging the potential for successful impact of the proposed research. The productivity of the Centers was judged to be appropriate to excellent for an investment of the level required for the BRCs.

Recommendation: *Maintain appropriate review and oversight to insure that BRC research remains focused and consistent with the funded BRC research programs, and not overlapping or competing with other funded programs, including related SFA initiatives.*

Recommendation: *On a related point, the goals of the BRCs and ‘biofuel’ SFAs are not clearly linked, and it is sometimes unclear how the activities within the BSSD may relate to one another, and whether different national laboratories are brought together to develop a unified strategic plan. The COV recommends that a unified strategic plan be developed for the BRCs and biofuel SFAs*

The Artificial Retina Project

In addition to, but outside of the scope of the BRC or SFAs, we would like to highlight the success of the Artificial Retina project that was completed in 2011.

Although there was no review or process on this project that is relevant to the charge of the COV, we felt it appropriate to recognize the success of this project. Since termination of the project in 2011 a commercially available artificial retina received FDA approval for broad clinical use in 2013 and was ranked as the number one medical technology breakthrough for 2014. This seems to us to be an example of an important biomedical outcome that would not have occurred without the commitment and resources of the DOE.

Workshops

Support for conferences and workshops (5 in 2011, 12 in 2012, and 9 in 2013) was provided through the open FOA in consultation between the requestor and individual PMs. Decisions for funding were made internally based on availability of funds and fit with programmatic goals. A large variety of conferences and workshops were supported with funds ranging from \$5-40K.

The COV felt that this was a good use of discretionary funds and supported a worthy range of meetings on topics relevant to the DOE.

