BASIC ENERGY SCIENCES ADVISORY COMMITTEE
To the
U.S. DEPARTMENT OF ENERGY

PUBLIC MEETING MINUTES
December 9, 2020

Virtual Meeting

DEPARTMENT OF ENERGY BASIC ENERGY SCIENCES ADVISORY COMMITTEE SUMMARY OF MEETING

The U.S. Department of Energy (DOE) Basic Energy Sciences Advisory Committee (BESAC) convened the virtual meeting on Wednesday, December 9, 2020 via Zoom. The meeting was open to the public and conducted in accordance with the requirements of the Federal Advisory Committee Act. Information about BESAC and this meeting can be found at https://science.osti.gov/bes/besac

BESAC Members Present:

Marc Kastner, BESAC Chair, MIT, retired
Kathy Ayers, NelHydrogen
Joan Broderick, Montana State University
Beatriz Roldan Cuenya, Fritz-Haber Institute of the Max Planck Society
Helmut Dosch, DESY
Thomas Epps, University of Delaware
Cynthia Friend, Harvard University
Yan Gao, General Electric Company, retired
Julia Hsu, University of Texas, Dallas
Despina Louca, University of Virginia
Allan McDonald, University of Texas, Austin
Pietro Musumeci, University of California, Los Angeles
Monica Olvera de la Cruz, Northwestern University
Nai Phuan Ong, Princeton University
Abbas Ourmazd, University of Wisconsin, Milwaukee
Ian Robertson, University of Wisconsin, Madison
Anthony Rollett, Carnegie Mellon University
Maria Santore, University of Massachusetts, Amherst
Andrew Stack, Oak Ridge National Laboratory
Esther Takeuchi, Brookhaven National Lab/Stony Brook University
Matthew Tirrell, University of Chicago

Designated Federal Officer:

Linda Horton, Acting Director, Office of Basic Energy Sciences (BES)

Committee Manager:

Katie Runkles, Program Analyst for the Deputy Director for Science Programs

BES Management Participants:

Bruce Garrett, Director, BES Chemical Sciences, Geosciences and Biosciences (CSGB) Division
Andy Schwartz, Acting Director, BES Materials Sciences and Engineering (MSE) Division
Peter Lee, BES Scientific User Facilities (SUF) Division

Wednesday, December 9, 2020

BESAC Chair, Marc Kastner called the meeting to order at 11:00 a.m. Eastern Time to an audience of approximately 234 people and requested all BESAC members introduce themselves.

Office of Basic Energy Sciences Update, Linda Horton, Associate Director, Office of Basic Energy Sciences

Horton discussed BES statistics and personnel, highlighted efforts in FY20 and plans for FY21, and concluded with recent BESAC impacts. Funding from BES crosses all 50 states and new grants have a 25% success rate. In FY20, 39% of the BES budget was in research. BES has a number of vacancies and the office is working through these. Horton welcomed Dr. Athena Sefat, the new Program Manager for Physical Behavior of Materials in the Materials Sciences and Engineering Division, and Dr. Brandon Rohnke, the new American Association for the Advancement of Science (AAAS) Science and Technology Policy Fellow. Horton congratulated three Department of Energy, Office of Science (DOE-SC) Distinguished Scientist Fellows, Dr. José Rodriguez, Dr. Jacqueline Chen, and Dr. James DeYoreo.

Since July 2020 there have been special Funding Opportunity Announcements (FOA) for Quantum Information Science (QIS) Centers, Artificial Intelligence/Machine Learning (AI/ML) for User Facilities, Materials and Chemical Sciences Research on Critical Materials, and Materials and Chemical Sciences Research for Direct Air Capture of CO_2. Technical highlights shared were CO_2 Reduction to CO with 19% Efficiency in a Solar-Driven Gas Diffusion Electrode Flow Cell at the Joint Center for Artificial Photosynthesis (JCAP), Quantum-Chemically Informed ML for Fast and Accurate Prediction of Energies of Large Molecules at the Joint Center for Energy Storage Research (JCESR), Design of Processive Catalyst for Polyethylene Upcycling (Ames Laboratory), and Visualizing Single Photoemission for Atomic Defects in 2-D WS2 with Atomic Resolution at the Center for Novel Pathways to Quantum Coherence in Materials (NPQC) Energy Frontier Research Center (EFRC) at Lawrence Berkeley National Laboratory.

In FY20 all 12 SUFs were funded at 100% of optimal level. The Coronavirus Aid, Relief, and Economic Security (CARES) Act covered additional expenses for COVID-related research. The National Synchrotron Light Source II (NSLS-II) and the Advanced Photon Source (APS) coordinated operating schedules to optimize access for COVID research. The Stanford Synchrotron Radiation Lightsource (SSRL) and the Advanced Light Source (ALS) faced California wildfires and electricity shutdowns in addition to COVID challenges yet delivered 4,500 and 3,200 hours, respectively, with 88% (SSRL) and 84% (ALS) reliability. The Linac Coherent Light Source (LCLS) successfully produced first light through the newly installed hard x-ray undulator in July, followed in September by first light through the soft x-ray undulator. The Spallation Neutron Source (SNS) adjusted its operations to deliver an additional 200 hours above the planned 4,600 hours with 95% reliability. And the High Flux Isotope Reactor (HFIR) delivered 3,600 hours of operations with 88% reliability. Despite a long outage LCLS began COVID-related research in August 2020. BES SUFs supported over 12,500 users in FY20, a reduction of over 20% from FY19 due to COVID-19. The pandemic also increased remote use of all the facilities, and led to adjustment of the approach to counting remote users from one remote user per experiment to counting additional users for those experiments. Since January 2020 there have been 146 protein structures characterized in SARS CoV-2 based on data from BES light sources, providing key details on how the virus modifies its messenger RNA when in the body and thereby contributing to drug and vaccine developments. Research at the Nano Science Research Centers (NSRC) on personal protective equipment and virus detection continues to be important.

In FY20 BES had a large number of active construction and major items of equipment (MIE) projects – 8 active, funded projects compared to the historical average of 5-6 projects at a time. LCLS-II was rebaselined in October with a new Total Project Cost (TPC) of $1,136M and a delay in CD-4 schedule to January 2024. The APS Upgrade (APS-U) had an Office of Project Assessment (OPA) status review in September 2020. The ALS-U completed a Critical Decision (CD)-2 review in November 2020. The LCLS-II-High Energy (HE) is at CD-1 with long lead procurements and completed an OPA review in December 2020. The SNS Proton Power Upgrade (PPU) received CD-2 and CD-3 approval in October 2020 and the SNS Second Target Station (STS) had CD-1 approved in November 2020. Two active MIE's are the NSLS-II Experimental Tools-II (NEXT-II) which received CD-1 in September 2020, and the NSRC Recapitalization is scheduled for an OPA review for CD-1 in December 2020.

The FY21 President's budget request for BES was $1.935B. The Senate Mark is $2.215B and the House Mark is $2.242B. There is currently a continuing resolution (CR) in effect and BES is proceeding at a conservative level of support for operations and construction.

FOAs for FY21 that have been announced include the Early Career Research Program, the Established Program to Stimulate Competitive Research (EPSCoR) Implementation Awards, the Computational Chemical Sciences FOA, and Scientific Discovery through Advanced Computing (SciDAC).

In strategic planning the report for the Data for Scientific User Facilities roundtable was posted and there is continued progress towards the full report on Basic Research Needs for Transformative Manufacturing. Planning is underway for the BES Roundtable on Cryogenic Electron Microscopy in the Physical Sciences to be held in Spring 2021. The Council on Chemical Sciences, Geosciences, and Biosciences held a workshop in September looking at the seamless integration of data science, chemistry, and biochemistry. In January 2021, a workshop is planned on the synergy between chemical separations and reactions.

During the last meeting BESAC approved the neutron subcommittee report on The Scientific Justification for a U.S. Domestic High-Performance Reactor-Based Research Facility. CD-0 (mission need) for the HFIR pressure vessel replacement has been approved. This project will enable HFIR to return to 100MW operations, and with design enhancements will allow additional cold neutron-based research, upgrades to beamlines, enhancements for the isotope program, and future operational flexibilities. The 2018 MSE Division Committee of Visitors (COV) report recommendation to hold COV activities less frequently was approved by the BESAC Chair, and BESAC will be asked to vote on extending all COV activity intervals beyond a 3-year rotation.

Discussion

Roldan Cuenya inquired about increased allocations for remote operation of synchrotrons and user facilities as well as plans to increase the allocation of personnel funds to set up the equipment for remote operations. **Horton** said that the CARES funding investment included personnel funds for remote operations. There was a need to bring in more IT and facilities staff to exclusively attend to the experiments in collaboration with their online colleagues at national labs, universities, and research institutions. There is a scheduled workshop over multiple days looking across SUFs to discuss the issues of the effect on staffing and equipment and individual facility investments.

Dosch asked about an overall, coherent policy of DOE implementing AI/ML in various scientific activities, including SUFs. **Horton** noted that the workshop on SUFs is internal and focuses on changes for remote access. AI/ML is a cross-DOE initiative and is articulated throughout the DOE. In the Office of Science, AI/ML reaches across all six programs. BES is investing in research that is specific to the needs of BES disciplines and BES SUFs. BES has an historic coordinating partnership with the Advanced Scientific Computing Research (ASCR) program and the ASCR engagement in BES FOAs will continue. **Ourmazd** added that there was a cross-DOE series of town hall meetings on AI for Science with a report available soon.

Stack asked about the effects of COVID on research activity, solicitation responses, and the ability of researchers to complete their work. **Horton** stated that there has not been any major impact on the numbers of proposals received and DOE-SC has implemented generous policies for reporting delays for grants and related activities. Additionally, there was either an official delay for the entire FOA or specific allowances for COVID-related delays for proposal submissions. Most institutions seem to be accommodating their planning to include COVID-related elements. Regarding the effect on researchers' work, DOE-SC has conducted a survey of principal investigators (PIs) to assess the impact of COVID on their research activities. This information will help identify real needs and accommodations. Professional societies are also looking at this carefully and DOE-SC is following those studies.

Rollett requested Horton comment on the impact of COVID on construction projects. **Horton** shared that the LCLS-II was in active construction, had the biggest impact, and required rebaselining from both a cost and schedule perspective. There are some impacts at the APS-U but not at the level that would require rebaselining. Other impacts are regionally dependent on State mandates and allowances.

National QIS Centers Update, Ceren Susut, Office of Advanced Scientific Computing Research (ASCR)

Susut discussed the key activities within the DOE-SC where the majority of the DOE investments are made in QIS. She also highlighted the importance of the National Nuclear Security Administration investments in the weapons labs that enable this work.

QIS crosses the technical breadth of the Office of Science. The strategy is divided into two parts, investments that DOE-SC can make to 1) advance QIS as a field, and 2) advance the science mission. Each DOE-SC office is investing in programs that are relevant to their missions. The DOE-SC investment goals are to advanced quantum computing, quantum communication, and quantum sensing.

The DOE-SC has been ramping up QIS investments since 2017 and the FY21 budget request approaches $250M. Work on the National QIS Research Centers began in December 2018 with a community input strategy. The first Request for Information was in May 2019. The community input was incorporated and the solicitation was issued in January 2020. Announcements for the five National QIS Research Centers occurred in August 2020 along with a new website that integrates the investments made and provides an overview of activities.

The DOE-SC introduced a concept, the QIS Science & Technology (S&T) Innovation Chain, which facilitates coupling with industry at different levels to advance QIS as a field. The S&T Innovation Chain consists of five levels: fundamental science, devices, systems, prototypes, and applications, with five complementary areas of interest. The overall goal is to advance the field as a whole and to facilitate industry engagement and technology transfer. The DOE-SC wants to make sure that the overall portfolio has a balance in the overall chain. Each center focuses on technical areas of interest relevant to more than one program office and these are overseen by multiple program managers thus covering a large scope of the QIS field.

The portfolio fully leverages the DOE facilities across the lab complex but will also build new capabilities. For example, QNext plans to build quantum foundries at Argonne and SLAC, incorporate industry capabilities, and use international facilities. The Fermilab-led Center has a collaboration with Gran Sasso in Italy to use the largest underground laboratory in the world. The Centers will play a role in the overall QIS ecosystem stewardship. There are 69 institutions from 23 states plus the District of Columbia, Canada, and Italy. There are connections with other agency efforts as well, such as the National Science Foundation (NSF) Quantum Leap Challenge Institutes. Every center has unique approaches for workforce development and they are creating common activities in this area.

QIS in the DOE-SC is a long-term effort. As the largest supporter of the physical sciences within the nation the DOE-SC goals for QIS encompass multiple timescales. The investments must have national impact and involve all the DOE-SC programs to wholly advance QIS. Examples of this include community engagement and information exchanges, alignment with the national quantum strategy, unique resources to support U.S. careers, and unique programs that provide access to multiple industry platforms. The DOE-SC would like to invest in a secure quantum internet for national security and is continuing to make investments for enrichment capabilities for isotopes of critical importance to QIS. The SUFs are adding QIS-specific technologies to their existing capabilities and there are agreements in place to collaborate with different countries. Lastly, the DOE-SC invests in programs to explore pre-competitive technology, such as quantum testbeds, to mitigate risk for industry.

Discussion

Kastner asked that questions be reserved until after the panel discussion on QIS.

SC & BES QIS Panel Discussion, Ceren Susut, ASCR; Mick Pechan, BES; Tom Russell, BES; & Tom Settersten, BES

Susut introduced panelists Tom Settersen, Mick Pechan, and Tom Russell, who helped launch and oversee the QIS centers. Horton explained that this would be a question and answer panel concerning how BES is managing its quantum portfolio.

Hsu asked for clarification on evaluation of the Centers' progress and whether teams have the flexibility to reshape their teaming partnerships in the future. **Pechan** said that each Center has milestones related to the five areas of interest: quantum communication, computing and emulation, devices and sensors, foundries, and materials and chemistry. The areas of interest are currently being formulated more specifically and will be evaluated on a scheduled basis. The Centers do have the flexibility to change partners and the change control model used by the EFRCs and Hubs is being used for major directions and major participants. The Centers are expected to be both agile and directed. **Russell** added that these types of issues were addressed during the review process for the FOA and during the pre-selection interview stage.

Ong asked if the Centers plan to deliver products or are focused on fundamental, unconstrained science. **Settersten** explained that the Centers needed to address some of the elements within the S&T Innovation Chain up to prototypes, for example. However, some Centers are further along the Technical Readiness Level (TRL) than others. **Susut** noted that the DOE-SC is a basic research organization and that component is important, but DOE-SC is also looking at the QIS field as a whole including use-inspired research. There is no expectation of a product, however each Center did propose to deliver research products and will be held to that. **Pechan** added that almost all of the Centers have a co-design aspect where the end of the S&T Innovation Chain is working to inform the fundamental science.

Gao requested that the panelists discuss the TRL of the referenced prototypes and applications and share how success will be measured. **Susut** said the TRL is 0-1. The goal is to ensure the Centers keep the applications in mind for their solutions, but there is no expectation of an end product. **Gao** remarked that engagement with industry requires a higher TRL than 0-1. He asked how engagement with industry will be meaningful and constant (on the application side) throughout the lifetime of a Center. **Susut** explained that most every Center has industry partners. The partners contribute to the Center via cost-sharing; that is the commitment from the industry side. Every Center also has multiple boards: Industry Council, Advisory Board, International Board, and others such as a Diversity Board. Although those are not necessarily funded by the Centers they are important in terms of demonstrating the overall commitment to the ecosystem.

Ourmazd asked about the mechanism in place to identify and sustain unique, unexpected, and potentially promising developments, illustrating that small cross-cutting proposals and promising activities that are interdisciplinary in nature generally find little support and fall through the cracks. **Pechan** said that at the program level there is encouragement to fund high-risk/high-reward projects. There are QIS-related EFRCs and all of the programs have QIS budgets in their core-funded portfolio. **Susut** added that one goal of the Executive Council is to identify and create cross-cutting areas and common processes to advance QIS science to reach the overall portfolio goals. **Russell** explained that such opportunities are expected to be embedded in the Centers and part of the criteria for standing up a Center was to address how high-risk/high-reward activities would be considered as a piece of the Center. The QIS Core Research Working Group, made up of members from all the program offices in DOE-SC, intends to coordinate QIS research across DOE-SC to make people aware of the incoming activities and projects to develop a structure for communicating with each other when such proposals are presented.

McDonald inquired about the fraction of the BES science spending allocated for the QIS Centers and the considerations that were taken into account to determine that level. **Russell** said that the amount invested in the Centers was determined at the senior management level. The amount of spending in FY20 across DOE-SC is $75M of which ~$25M comes from BES, with future amounts determined by Congressional Appropriations. **Pechan** added that $25M is just for the Centers. **Horton** noted that in FY20 the BES investment for research was $840M. She added that because of the QIS investments across BES, QIS-related research is not easily tallied.

Ayers asked for metrics on the sizes of companies working with Centers, noting that while large companies can have a large influence individually, small companies, as a collective, can have a lot of influence as well and that a lot of the high-risk/high-reward industrial research is happening in those small companies. **Susut** said there is a variety of small to large companies, start-ups to big companies. Overall there are 14 companies involved across two different groups: quantum technology developers and quantum technology users. Some companies, for example, are interested in quantum applications for their business purposes rather than development.

BESAC was dismissed for a break from 12:40 p.m. to 1:05 p.m.

International Benchmarking Updates, Cynthia Friend, Harvard University; Matthew Tirrell, University of Chicago

The subcommittee is divided into two teams – one on Scientific Areas (Team 1) and one on Strategies (Team 2). The Charge directed BESAC to examine the U.S. competitiveness and leadership in key areas of mission-relevant research and facility capabilities, provide advice on modifications to existing tradeoffs or new ways to leverage scarce resources, and identify incentives that will retain and attract scientific talent.

Meetings began in August 2020 to identify key topics, gather and analyze data, and create a report outline. Beginning in January 2021 the subcommittee will integrate the data and ideas, develop recommendations, and write drafts to deliver a final report to BESAC in July 2021. To be accessible to a broad audience the report will have stories interleaved throughout to create interest and context for the material discussed.

Team 1 identified Scientific Areas (QIS, Science for Energy Applications, Innovative Use of Matter for Energy and Information, Industrially-relevant Science for Sustainability, and Advanced Tools (Cross-Cutting)) that are important to BES, utilizing Basic Research Needs reports and expertise to complete the task. The Scientific Areas were ranked and deep-dive topics were selected to develop a qualitative picture of the current and future competitiveness of an area. Discussions were held with experts to identify the deep-dive areas, then international conferences were analyzed in terms of the origin of invited speakers or plenary lecturers, and a citation analysis was conducted on the conference data. This methodology provided a semi-quantitative, data-driven approach to compare to the initial discussion-based approach. In the coming months, this team will identify other metrics such as major awards and will invite the broader community to provide input.

As a whole the U.S. and European Union (EU) are leading across all five areas mentioned while Asia is behind. Specifically in QIS, the EU is ahead of the U.S. While the conference analysis method is semi-quantitative the interpretation requires judgment. Team 1 is considering questions about appropriately capturing Asia: only English-language conferences and journals, visa and travel issues, and new and emerging experts that are not included in conference invitations. Team 1 made spot checks to determine if the data are robust. The qualitative outcome showed possible evidence of geographic influence on who attends the conferences. Team 1 also conducted a citation spot check analysis of speakers from the conference data. This activity also indicated a geographic advantage in citations (higher citations are associated with the author's home country (e.g., U.S. author = higher U.S. citations). Another citation spot check utilized the Web of Science "Highly Cited Researchers 2020" report and found qualitative consistency with the Team's findings. The percent of highly-cited researchers in "all science fields" are in the U.S. (41%) and EU (>23%).

In summary, Team 1 has generated and analyzed data from consultations and conference analysis. Additional analysis, including prizes, is underway. The data sometimes does not agree with the expectations of the team members based on their own knowledge of the fields. The challenges Team 1 is addressing is the geographic influence for conferences and citations, interpreting variability, and consideration of other evaluation methods which may require professionals in different areas, such as library science. Lastly, broad community input for awareness, vetting, and feedback is yet to be completed.

Team 2, Strategies, work has all been by consultation with no attempt to be quantitative. A lot of time was spent considering who to consult, discussing and refining questions to ask of each category of consultant (lab, NSF, foundation, university, industry, and international leaders, and early career scientists), and then conducting the calls. From 40+ call notes six consistent hypotheses were extracted for testing: 1) the U.S. is losing good talent, 2) European facilities work better for producing science because of staff support and resource (access) allocations, 3) stronger investments in infrastructure are needed, 4) there is concern about early career investigators (attrition, financial support, transition into mid-career), 5) enhanced international cooperation would improve U.S. competitiveness, and 6) there is more that can be done to increase hand-offs from basic research to higher TRLs, and that some of the stimulation from applied and industrial research should be used to inform, motivate, and stimulate basic research.

While there are clear high-powered examples of why people have left the U.S., there is something more nuanced happening. Historically, it was almost a necessity for a young scientist to come to the U.S. for training. That seems unimportant now. In terms of facilities, in the U.S. there is a pent-up interest (from Directors) to be able to do planning beyond 10 years, to think 20 or 30 years into the future. Equally important and potentially related to the talent issue is that people who are planning their future, just coming out of graduate school or their postdoc, want to know that their careers will be well-supported. The idea of involvement in long-term planning and imagining future facilities seems to be an emerging theme as well. Considering basic, use-inspired, and applied research, it is clear that BES should focus on the basic sciences, but from the point-of-view of PIs there is tremendous interest in having a pathway to translate basic research to use-inspired and applied work as well as working with industry.

Team 2 is now considering how to test these hypotheses. Some avenues considered include seeking supporting data, developing anecdotes, pursuing more pointed discussions, seeking more sources, and assembling an online panel discussion with sources. The results identified thus far include several areas of concern; these are thus far diagnoses rather than therapies. Further analysis and consultation will be completed and there has been some effort toward strategies for success in the fields studied by Team 1.

There is a need for meaningful community feedback. Potential methods suggested were reviewing a draft report, arranging meetings through scholarly societies, and developing a web page with results and an opportunity for input.

Discussion

Epps asked if older data from the Highly Cited Researchers list has been explored to determine trends and if these data could be used as a proxy for the issue of a lack of a need for EU and Asian scientists to come to the U.S.? For example, if there is an uptick in the highly cited researchers from the EU and Asia, is that indicative of metrics that can be used to support Team 2's hypothesis? **Friend** explained that one challenge in the Highly Cited Researchers data is that these are just numbers. A terrible paper, for example, can be published and have many citations because people are trying to disprove the results. The difficulty is how to take sheer numbers and differentiate numbers of citations from actual scientific impact. Team 1 has discussed how to identify emerging leaders as it is difficult to analyze data on citations.

Epps asked if there is a way to get data on individuals who have, and have not, received mid-career development opportunities at universities and look at the satisfaction or retention rates as a means for a semi-quantitative assessment. **Tirrell** said that Team 2 has talked with early career awardees from DOE-SC and has collected some quasi-quantitative data. Mid-career scientists come from early career awardees and movement decisions to mid-career are based on what is available at the time. **Musumeci** added that this topic came up in a number of consultations with early career individuals who are looking forward. The comparison with funding schemes in different areas also arose. There is a difference between an early career in universities versus labs; the perspective and ways to secure mid-career funding is different.

Hsu stated that looking at the data on who is invited to conferences is tricky. She suggested that the slope or trend is a better metric. In terms of getting broader communication input she said that a website would provide data earlier but may also supply unwanted or unmanageable data. **Friend** agreed and stated that one question to address is how to parse through that data.

Kathy Irish [via zoom chat] mentioned using patent data for fields that are closer to industrial applications, saying that a lot of cutting-edge research shows up in patents. **Friend** indicated that while patents had not been considered, that falls into a literature analysis of a different sort. She asked for more information in terms of a process, how to actually evaluate it? **Irish** suggested identifying which countries are patenting in certain areas and consider those trends relative to the publications.

Robertson voiced that getting library scientists involved is wise as some of the approaches they have used for publishing trends and collaborations can provide insight. Additionally, he cautioned that while it is impossible to cover all the subject areas in BES a down-select always introduces the danger that those left out will wonder if their area is no longer important. He recommended stating that the examples were selected for this study and do not represent a value judgment for other areas. **Friend** mentioned that the report will state that the subcommittee only took specific areas as examples and will write a brief statement based on the qualitative information received from the consultations. However, the subcommittee is mindful that there will be sensitivity that someone's field is left out. She asked if Robertson was suggesting that getting library scientists involved at least for a spot check is a good idea. **Robertson** confirmed the idea, adding that just getting the right people to look at the data will be useful. Library scientists are very good at putting things together, looking at where the papers are published, what the subject matter is, and making connections between countries of the authors of those papers. One of the things you (Friend) mentioned was international collaborations and how that can be strengthened. It might be that the U.S. is already collaborating quite widely and broadly. Library scientists may be able to obtain information on those international collaborations.

Dosch provided three comments. First that the subcommittee strive to get away from static analysis cautioning that a snapshot of a certain situation could be extremely deceiving and the field could be changing dynamically. Second that the one thing deciding the future of science and development in the U.S. is being the most attractive place for the next generation of scientists. The current generation is extremely critical and very sensitive to developments. They want to understand the lifestyle. They come with their families and they want to be in a social situation that is comfortable for themselves as well as their family. And third, he confirmed that the analysis of facility impact is very difficult and that there are only a few examples of where it has been done successfully. **Friend** said that most facilities have a list of publications derived from work done at the facilities. While that could be gathered she was unsure how to analyze it and if it is of value. **Dosch** stated that it is one component of many. Impact elements include the development and future placement of highly skilled people, performance improvements of existing businesses, improvements to public services, and attracting research and development investments from business.

Rollett suggested that BES ask all of its researchers to name their competition, to name people and institutions, and provide keywords that apply to one's research. A fairly straightforward citation search on that information could then be performed.

McDonald commented that in terms of strategy it is useful to find out what is most important to young scientists for the future; is it predictable research support, facilities, or issues of the climate? Knowing what is important is the first step. **Friend** confirmed that McDonald's meaning of the word "climate" was the ability to balance work life and family life.

Roldan Cuenya stated that to help remove bias when looking at conferences it is important to include the location and consider the organizers. Relaying her experience living in the U.S. and Germany she noted that some of the major differences in the countries have to do with the technical and administrative support at the university level. She suggested investigating the levels of support, perhaps from the laboratories and nanoscience centers. She explained that it would be useful to compare how the beamline is staffed or how many people are responsible for specific areas. In universities she proposed looking at the advanced undergraduate courses in key areas in programs and to compare that information across different countries, explaining that gaining access to PhD students may be influenced by whether they have laboratory access or by the number of people in the labs. **Friend** appreciated the points made and noted that teaching or class size aspects are outside the scope of the study. She added that it will be difficult to get meaningful data because there is wide variation even within a university, from different departments, different subfields, let alone different organizations.

Shen responded to the comment about conferences and expressed that the panelists' judgment played a role here. In 2019 there were 150 QIS-related conferences compared to ~20 conferences five years ago. In such a case of extreme growth Team 1 picked 20 conferences that were the most representative (internationally based, changing geographic locations). Team 1, like Team 2, found that the U.S. and EU are generally competitive when it comes to attracting talent. While citation data has its own issues, when it is analyzed along with the conference data there is more confidence. **Hsu** replied that while more confidence is garnered when two things agree, in this case the conference and citation data have the same bias. The bias yields the same result which does not boost confidence. She suggested following Rollett's idea about a website to collect PI information on their major competitors. **Shen** clarified that in this case Team 1 attempted to remove the bias. For example, using an exclusive count. If a conference was in the EU, the team excluded all Europeans. The same qualitative picture emerges when conducting a similar exclusive count to the citation analysis. It is very tricky but that is what the team is trying to do based on the data. That is one reason we are discussing doing a more detailed citation analysis. **Musumeci** suggested, on the community input website, having a section reserved for early career input. **Isaacs** noted that for Team 2 consultations are providing the best data. He recommended asking people why they chose to leave the U.S. **Friend** confirmed that it is critical to be cautious about targeting one group on the website as it introduces many issues.

Epps noted that the U.S.-Japan conference has a 50/50 split of participants from the two countries. While already a selected group, their citations can be tracked. He asked if this might be a way to eliminate bias in terms of the organizers from various countries. The topics in the U.S.-Japan conference are chosen annually and may or may not all pertain to BES. He suggested borrowing their information to create a less biased assessment.

Gao articulated a way to evaluate facilities is to subdivide a facility into 10-20 disciplines, send such a table to group leaders at the lab, and ask them to rank the SUF by the subdisciplines in terms of U.S. leadership. That table of results could then be sent to the broad community for comment to get a clearer picture.

Kastner dismissed BESAC for a break at 2:30 p.m. and reconvened the meeting at 3:00 p.m.

Office of Science Distinguished Scientist Fellow Presentation, James DeYoreo, Pacific Northwest National Laboratory

DeYoreo focused on interfacial dynamics in self-organizing systems. The 20^{th} century view of materials synthesis was shaped by the theories of J.W. Gibbs and Sir Charles Frank. Gibbs proposed the first theory of how materials nucleate. His view was that individual monomers (ions, molecules, colloidal crystals) come together to form the first nascent particle of the new phase which happens because of a drop in chemical potential but opposed by the creation of an interface that has interfacial free energy alpha. Post nucleation formation of ordered materials, crystal materials was first correctly described by Sir Charles Frank in the mid-20^{th} century who developed the terrace-ledge-kink model in which the formation of materials is a monomer-based picture where atoms, ions, molecules, or colloidal particles interact with a surface that consists of atomic steps and kink sites. This picture held well until ~2000 when other types of paths to nucleation were realized including amorphous precursors, liquid droplets, and nanoparticle assembly. While there are complex pathways that arise from both thermodynamic and kinetic reasons, the challenge is determining in what systems they occur and why.

The dynamic processes that lead to self-organization happen in many systems. DeYoreo illustrated these processes in the liquid-solid interfaces that underlie the synthesis of many materials. The systems include synthesis by oriented attachment (ZnO nanowires and what happens as particles come together), self-assembly of engineered proteins (self-assembly of de novo designed proteins), and heterogeneous nucleation of crystalline phase on top of another (formation of Gibbsite on mica). These three examples represent three levels of collaboration: between BES programs that cross MSE and CSGB, between national laboratories and universities, and between BES (MSE and CSGB), national laboratories, and U.S. and International universities.

The oriented attachment process is driven by direction-specific forces that must overcome significant hydration barriers. In any particular pair, at a fairly significant distance apart, one can track the orientation of particles; they are rotating into alignment before coming into contact. That means that tractive interactions bring the particles together and torques act at distances beyond 5 nm. By analyzing the position of all the particles in the system we take the radial distribution function, invert it, and create potential energy versus distance – this is the experimental potential measured in units of kT versus separation distance. The potential is a monotonically downward decreasing function meaning the particles are attracted to one another and there is no significant barrier observed in the system. Xin Zhang at Pacific Northwest National Laboratory manufactured synthetic, single crystal tips and made them AFM cantilevers to bring them down onto a like material. By rotating the substrate Zhang measured how strongly bound the surfaces are to one another as a function of relative crystallographic orientation. The difference between the most strongly bound direction and the most weakly bound direction is ~8.8kT. However, in molecular dynamics simulations on these systems there is an orientation dependence potential between the surfaces and a set of minima which correspond to integer numbers of water layers between the particles. In the minima that is separated by one water layer the difference is similar to what was measured experimentally (16kT). But the real problem comes in in two ways: 1) the barrier that must be overcome to get into the minima is enormous (50kT). The question is how do these particles actually get together? And 2) these experiments show that these particles see each other at much greater distances in terms of tractive interactions and torques. Particles with a permanent electric dipole moment and potentials and torques scale with $1/r^3$ and will align to one another when they are close enough. Therefore, the answer is that a permanent electric dipole drives this system into alignment to form nanowires oriented along the [001] direction.

DeYoreo described a special kind of particle, a nanorod designed to have a set of carboxylate groups on the bottom of the protein nanorod. At low salt concentration (10 mM KCI), each carboxyl group will lie exactly on a potassium site, provided the nanorods of the protein lie along one of three close-packed directions. A salt concentration at 100 mM KCI will cause these close-packed domains of co-aligned proteins to lie in all three directions. Increasing the salt concentration to 3 M KCI creates a 2D smectic phase with over 1 billion proteins on the substrate, all aligned into a single domain of a 2D smectic phase. Higher salt concentration shows that these nanorods eventually align to a smectic phase. By introducing programmed interaction between the nanorods the phase can be changed. For example, by introducing a hydrophobic interaction between the ends of two rods they will assemble into nanowires that are one protein wide that spans the entire length of the sample. However, by building in two interfaces, one a dimeric interface and the other a 3-fold symmetric interface, they will assemble into hexagonal arrays (honeycomb structures) where the size of the pore can be programmed by the number of alpha helices in the length of the arm. However, this was not designed to make open lattices, rather it was designed to make closed lattices where the interactions were between arms. Steve Grannick predicted this result. He predicted that the trimetric shaped colloids will form open arrays due to solve in entropy.

These protein systems represent a mix of interactions. The effects of surfaces, salt, and inter-rod interactions reflect entropic drivers of colloidal crystallization. However, the programmed interactions modify this to produce phases that do not otherwise exist. In a colloidal system you will get condensation into a hexagonal colloidal crystal above a certain concentration because once the particle density becomes too high water is being crowded out. In order to increase the free volume of water, or its ability to move around, the particles must be pushed together. If one introduces a surface into the system then a monolayer of these particles will form first because the wall is constraining the movement of water – this is a way of increasing solvent entropy. As the concentration is increased towards the critical concentration for bulk colloidal condensation we see a bilayer then a trilayer and so on to bulk crystallization. If solutes are introduced the system will be driven to form a monolayer or a colloidal crystal at very low particle concentrations. His team's system has specific interactions and that has an effect in the following way, in high enough concentration in 3D there will be a smectic array. A smectic array is not stable in 2D, yet there is one in the system. The reason is we have specific interactions programmed into the system. By using the interface and designed interactions the team is able to create new phases that would not exist otherwise if there were only colloidal forces.

Finally DeYoreo described the heterogeneous nucleation of Gibbsite on muscovite mica. The team used high-speed, atomically-resolved AFM to reveal three stages of gibbsite film formation on mica. There are three phases involved. The first phase is absorption of individual ions. Analyzing this data along with surface potential shows that the surface speciation is different from the bulk solution and is dependent on the pH. In the bulk solution Al 3+ dominates by orders of magnitude, but in the surface speciation as a function of pH the Al 3+ species is a minority species at pH's >3. What is not seen on the surface of $Al(OH)_3$ ions are the 2+ species (the dominant species on the surface). The next stage of this process is the formation of clusters out of these ions. These clusters have 3 to 40 $Al(OH)_3$ units created by raising the temperature. These fluctuating clusters enable the extraction of a cluster size distribution and direct extraction of the free energy landscape from clusters in the system to make comparisons to nucleation theory. The final phase is evolution of the clusters into islands which grow by coursing and coalescence, but never fully cover the surface. The reason they do not fully cover the surface or grow beyond a monolayer has to do with surface charge. As a function of pH, in the absence of $AlCl_3$ solution the surface charge becomes more and more negative. However, adding $AlCl_3$ causes the surface potential to go positive. This surface charge inversion rapidly increases with higher concentrations of pH. Because charge is being added to the surface there is a huge impact on the free energy of forming a cluster. There is a capacitance turn in the free energy, there is charge on the surface with respect to the bulk and with respect to the plane of zero charge, the Helmholtz plane in the system. Looking at the potential versus distance it reaches the potential at the Helmholtz plane and drops from there and similarly down into the bulk. A typical curve for nucleation occurs in the absence of this charging. If the saturation state is driven towards zero there is a sudden transition from essentially zero coverage to full coverage as the first cluster nucleates, takes over the system, and covers the surface. However, putting the capacitance turn in creates a situation where, within a single phase region, the shift from low to high coverage occurs in a relatively continuous fashion. At a chemical potential that is positive there are lots of small fluctuating clusters. Islands are formed as the chemical potential is lowered but positive values are still lain down.

The essential challenge going forward is to understand the collective outcome of three-way interaction between solvent, substrate, and solutes. Research questions include how to de-convolve entropic terms associated with solvent from specific interactions between chemical moieties, electrostatics, and van der Waals forces; how are surface chemistry and symmetry elements of an underlying substrate imprinted on overlying solvent; and what is the impact of surface charges and external E-fields in promoting, suppressing, or altering organization? The DOE-SC Distinguished Scientist project is addressing this in three systems using collaborations with researchers at the University of Washington, Argonne National Lab, and University of California Riverside. The outcome sought is a quantitative, mechanistic picture of the relationships between substrate, water structure, solute distribution, and the resulting interfacial dynamics and organization.

Discussion

Olvera de la Cruz asked if the nucleation process occurs with the addition of a large amount of salt. **DeYoreo** explained that a high enough salt content will cause nucleation in bulk solution. This does not happen on surface because the charge interface is driving it and once that charge is covered up the driving force for it no longer occurs. However, it is true that by crossing the solubility limit gibbsite will form on the substrate and in the solution.

Hsu asked if the aluminum source in the gibbsite project is changed, for example to Aluminum nitrate, how that would change the surface interaction. **DeYoreo** said the team would have to measure the surface potentials and use a triple air model to extract the speciation to answer the question with certainty. While the team had not done that, he speculated that it would not have a huge impact because the mica surface is pulling the positively charged ions down. It would certainly affect the solution structure but would not have a huge impact on the surface charge state on the free energy cluster formation.

Committee of Visitors for Chemical Sciences, Geosciences, and Biosciences Report Presentation, Andrew Stack, Oak Ridge National Laboratory

The CSGB COV represents a cross-section of experts in scientific fields relevant to BES. The committee was subdivided into three panels: fundamental interactions, photochemistry and biochemistry, and chemical transformations. Each of the three panels included a subject matter expert and a generalist. The COV report includes five findings, four recommendations, and three other comments and suggestions.

The findings are that the CSGB Program Managers (PMs) and personnel are highly informed, make balanced considerations, and demonstrate dedication and professionalism; the PMs take on an active role in implementing strategic plans; CSGB utilizes a diversity of methods and tools to improve the quality of proposals and reviews; CSGB Principal Investigator (PI) meetings were efficient, build a sense of community, and are a valuable feature unique to DOE; and the CSGB research portfolio is competitive and shows clear U.S. leadership in heavy element research, solar energy, and geomechanics.

The four recommendations focus on communication of funding decisions with PIs; reaching a broad range of potential PIs; continued support for PM travel; and research across programs and divisions within DOE-SC and new capabilities.

The three other comments and suggestions included a preference for in-person meetings and using virtual meetings to preserve travel budgets and increase the diversity of attendees to come. Second that a good BES review requires subject matter experts and reviewers who are familiar with BES research priorities and its mission. Thus the COV suggested that CSGB consider how to improve review quality in situations where small review pools were expected. And third that supplied review materials were adequate except for the Early Career Research Program where the COV was not given final selections because of institutional conflicts of interest.

Kastner paused the meeting for a short break from 3:56 p.m. to 4:00 p.m.

Comments from the Office of Science, Chris Fall, Director Office of Science

Fall thanked BESAC members for their contributions to the Office of Science, the DOE, and the nation and stated that the process of soliciting advice is taken seriously as is the advice provided. He said he had been privileged to have the opportunity to interact with each member in support of the Office of Science. Fall congratulated Horton and her team for achieving the CD-1 milestone for the STS.

DOE-SC and those that work on the government side, the lab complex, are doing well under the circumstances, working remotely and safely. The modest CARES Act Appropriation Congress provided has been well spent. The hope is that Congress will recognize the COVID impact on research projects and programs, particularly with the major projects where there is $500M of impacts due to COVID.

The National Virtual Biotechnology Laboratory (NVBL) is a remarkable story of the labs coming together to fight COVID and is proof that it is possible to work together in fundamentally different ways. Following COVID there will be opportunities for biosecurity, next-generation biology, bioeconomy, etc. and DOE-SC is thinking about how to organize the NVBL in the future. The Laboratories of the Future Initiative will address the question of what is a lab, is it a place with fences surrounding it or a capability that is distributed.

DOE-SC is proud to have the initial five QIS centers. The process of soliciting these centers has driven a culture change within DOE-SC with all six programs collaborating. The QIS Centers are a new collaboration model that joins other constructs such as the EFRCs and the

Hubs to unite people in the programs. The difference in this case is the mix of labs, academia, and industry in an explicit role defined in the larger Industries of the Future national conversation. All of those included in the QIS Centers were asked to contribute resources to truly have an investment in the Center. These large collaborations need to be balanced with intentional support for individual investigator-initiated research as well as a diversity of constructs. Fall expressed his support for a natural lifespan for the QIS Centers to encourage industry buy-in.

The Public Affairs Advocacy Communications operation was moved under the Deputy Director for Science Programs to ensure a close tie between programs and that function and to allow the program leads to tell an engaging story, to understand what is happening throughout DOE-SC, the entire U.S. government, and internationally. Fall stated that the U.S. must lead in science, must have world-leading facilities and scientists at labs doing science at scale, and must support world-leading science at U.S. universities and with our partners. The new Office of International Science and Technology Cooperation and Science Security will create a more integrated awareness of international issues, trends, and competition. And under the Office of Scientific and Technical Information is an effort on science metrics – science indicators, metrics, and analysis. A core team is being created, similar to what the National Institutes of Health (NIH) and NSF have to ensure program staff know how to make better investments and identify impacts that are not necessarily obvious.

Fall stated there have been a number of conversations with the Administration's transition team. He shared that the transition team is knowledgeable and very experienced regarding the DOE, labs, programs, and the Office of Science. Secretary Brouillette has directed DOE-SC to cooperate fully and consistently within the rules of the Administration's transition. Fall is encouraged for the future and stated that there is no reason the community should be worried.

Discussion

Stack addressed Fall's comment concerning new grants and renewals in the context of long-term research strategy. **Fall** clarified that in his opinion one needs to compete on a level playing field with new entrants and people who have new ideas. His concern is the word renewal and what that means. When DOE-SC does renewals they fall under an open FOA as opposed to a targeted FOA. **Kastner** commented that he expects the International Benchmarking study will provide information about the issues of a timescale of funding and the level of funding.

Olvera de la Cruz noted that funding continuity in NSF projects depends on the Division. For example, the Division of Materials Research has a lot of continuity due to large investments by the universities and groups. She agreed that the benchmarking study will provide a better picture about the idea of long-term investment in the Centers. **Fall** added that DOE, NSF, and NIH are on a spectrum of the Program Officer model. At the NIH the Program Officer has no discretion. However, at DOE the review is advisory, so the Program Officer has discretion on the awards.

Musumeci asked about the newly created office for accelerator science, its development and impact on other programs. **Fall** remarked that this is the first year for the office and he hopes to have a Center of Excellence on systems engineering at one of the labs with a Chief Engineer function to provide consulting. This is about the systems engineering of large facilities, about nurturing the supply chain, and ensuring there is a healthy community. A more principled and nuanced approach to the pipeline of people who can think about and manage these massive technical projects is important.

Friend thanked Dr. Fall for his service and the great work he has done, and especially for the reorganization of DOE-SC. The topic of continuity of funding is something that has arisen in the International Benchmarking study discussions. It affects the U.S.'s ability to attract and retain talent compared to international counterpart countries. Having continuity is something that the subcommittee has found to be important. **Fall** restated that BESAC's advice is taken seriously. He understands the spectrum but stated it is important not to get too comfortable. Whatever one can do to keep folks engaged and bring in new scientists is important.

Fall reiterated what a privilege it has been working with everyone in his role as Director of the Office of Science. He said he had, and still has, a lot to learn, but he wanted to personally thank everyone for making this the most enjoyable professional experience he has ever had. He restated his thanks for BESAC members' service and contribution to the DOE-SC mission and to the country.

Committee of Visitors for Energy Frontier Research Centers and the Energy Innovation Hubs Report Presentation, Ian Robertson, University of Wisconsin - Madison

The EFRCs and Hubs COV reviewed FY17 to FY20 and commented that BES does a great job of reviewing the EFRCs and Hubs, that BES PMs are actively engaged in the management of EFRCs and the Hubs and their involvement is a contributing factor to the overall success of the centers and programs, and that the portfolio is incredibly broad and exceptionally deep. The COV appreciated that FOAs now require new proposals to discuss how they were meeting the BRN reports, workshops, and roundtables. The COV attempted to look at national and international standing of portfolio elements but found it challenging to assess because of a lack of comparative benchmarking data. However, it was noted that the EFRC and Hub PIs are internationally recognized.

BES has done well fulfilling their responses to 2016 COV recommendations. The process for reducing the number of full proposals reviewed was well thought-out and well managed. The COV recognized that the EFRCs are on four-year review cycles with a new competition and this is an appropriate and excellent solution to the problem. The COV recognized that BES has taken steps to make the Hubs' reports shorter and clearer but noted that there are still some steps that can be completed.

The COV offered five findings and five recommendations related to EFRC funding reductions; timing of the FOA pre- and full proposals; streamlining management and oversight reports; ensuring diverse and balanced reviewers; and inclusivity and diversity. A sixth recommendation was to BESAC to consider the purpose and usefulness of Charge 2b.

The COV recommended that BES document the processes leading to a reduction in scope of work due to a funding reduction within PAMS; that communication of future funding directions and opportunities be made earlier and for BES to utilize the COVID-created change as a learning opportunity to broaden both reach and impact; that the EFRC and Hub reports be modified to be informative rather than cumulative and include changes in the scope of work or personnel, reason for the changes, and the impact; that BES have a diverse and balanced number of reviewers commensurate with the size of the program being reviewed and maintain flexibility to determine best practices for conducting future panels; and that BES panels be inclusive in terms of diversity of scientific expertise, institutional setting, and personal characteristics. The final recommendation was that BESAC consider the purpose and usefulness of Charge 2b on national and international standing to determine if what is learned from the COVs is useful given this is complicated, demanding, and unreasonable for a COV to complete given time and resource constraints.

Committee of Visitors Discussion BESAC Members

Kastner thanked Robertson and Stack for their leadership of the COVs and asked them to comment on the question of increasing the time between COVs from three years to four years. **Robertson** said that the quality of the oversight and the management of the EFRCs and Hubs is superb, it is of the highest quality and no fundamental flaws in what BES is doing have been found. The COV findings are incremental steps to improve the process. If there are not major problems found then four years is appropriate. **Stack** stated that the list of solicitations covered was a long list and included both proposals and pre-proposals and the ways the proposal are handled may be changing. The COV's conclusions and findings are similar to the 2016 COV and the overall conclusions are fairly similar. He suggested doing a 3-year COV once more because of the change to a three-PM down-select for pre-proposals. However, he did not believe these changes would create a major new finding. **Horton** explained that for the CSGB COV the timeframe considered would have been four years had the task been delayed another six months and that Chemistry would have had no more FOAs to review. In other words, what that COV addressed is the same as would be seen in a 4-year review.

Takeuchi asked Stack to elaborate on his comments on the benefit of panels. **Stack** stated that while DOE-SC panels are not allowed to come to consensus, one would want to use a panel to provide a chance to educate one another about the subject matter and nature of the call thus allowing one to write a more informed review of the proposal. **Horton** explained that under the Federal Advisory Committee Act (FACA) DOE-BES is not legally allowed to ask for consensus unless all reviewers are empaneled, like BESAC, and all reviewers are brought on as temporary government employees.

Hsu asked for clarification on the problems with reviewing every three years. **Kastner** said that a COV is a huge amount of work for BES staff. **Horton** explained that the Materials Sciences COV noted that the recommendations were no longer as significant as they once were. The question is if there are not significant issues to be addressed through a COV, and the Division or Centers are continuing to do well and there are opportunities to continue to improve, is it necessary to conduct a COV every three years versus four years. **Hsu** added that she was trying to understand the reason for four years and not five or six years. **Horton** said the flexibility would be welcomed. The EFRCs and Hubs will remain on a 4-year cycle. For the core research areas 3-year, 4-year, or 5-year cycles would be reasonable except for the number of FOAs to review. Flexibility would be useful to accommodate the future changes in management.

Epps asked Robertson if the review went to six years is there an opportunity for a more substantial changes and if the cycle could be longer. **Robertson** said he did not see six years as having a big impact. However, if BES were to get a negative report perhaps a COV would need to be run more frequently. **Hsu** suggested leaving the review cycle more flexible for BES staff to determine but not to exceed a set number of years. **Stack** added that the 4-year review period would provide an opportunity to look at consecutive renewals of a national lab or university project. It would be interesting to see if the renewal proposals contain the same elements, if reviewer comments were the same, or if the program is actually evolving in response, etc. He noted that this is beyond just evaluating the review process but it would provide the ability to see if consecutive renewals of the longer term projects are being handled in a reasonable way.

Olvera de la Cruz commented that for university departments program reviews are held every seven years. She asked Robertson if the COV looked at renewals and non-renewals of centers. **Robertson** explained that with the EFRCs the COV had a chance to look at the reviews on existing and new centers. In many cases there was new work being proposed, not just continuations of the same work. They were using data from previous funding cycles to articulate new challenges and propose new directions. There was typically a change in personnel where new individuals and new institutions were being brought on to help move the Center forward. These proposals were all reviewed at the same level of integrity as a brand new submission.

Roldan Cuenya voiced her support that reviews be completed on longer timescales. The DOE-SC PMs are extremely competent and conducting a COV every three years is too much; there are other ways to use their expertise.

Kastner called for a vote on the three topics of increasing the time between COVs and accepting the two COV reports. He noted that there was agreement to give BES more flexibility in determining how long the period should be between COVs. He stated that BESAC encouraged BES to take that flexibility so long as COVs occur every six years. All BESAC members were in favor of the proposal to increase the time between COVs.

Kastner asked for any comments or opposition to accepting the COV report on CSGB and called for a vote. BESAC unanimously accepted the report.

Kastner requested BESAC members voice any opposition to the COV report on EFRCs and Hubs and called for a vote. BESAC members unanimously accepted the report.

Public Comment Session

None.

Kastner adjourned the meeting at 5:14 p.m.

Respectfully submitted, January 8, 2021
Tiffani R. Conner, PhD, PMP, AHIP
ORISE/ ORAU