BER Project Assessment

BERAC Subcommittee on Project Prioritization
Himadri Pakrasi, Chair
Caroline Ajo-Franklin, Co-Chair
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Proposed Projects

1. Microbial Molecular Phenotyping Capability (M2PC)
2. Drizzle, Aerosol, and Cloud Observation (DRACO) Chamber
3. BER Data Center
4. Plant Transformation Capability (PTC)
5. Bioeconomy Accelerator Facility
6. Earth System Modeling and Analysis Center (ESMAC)
7. MIE* – EcoPODS and Smart Soil System (EcoPaSSS)
8. MIE* – Visual Proteomics Capability
9. MIE* – Phased Array Radar

*Major Item of Equipment

Subcommittee Timeline

February 8	Introductory Meeting
February 15	Meeting to review projects 1-3
February 22	Meeting to review projects 4-6
February 29	Meeting to review projects 7-9
March 6	Final project review meeting
March 22	First report draft completed
April 4	Second report draft completed – including formatting
April 12	Brief BERAC and receive additional input
May 1	Final report completed and transmitted to SC Director

Subcommittee Process – Membership and Meetings

- 9 projects for review by the Subcommittee
- ~2 Subject Matter Experts (SMEs) for most projects, with a total of 21 SMEs
- 1 Chair and 2 co-Chairs
- 24 total Subcommittee Members

Have completed 4 out of 5 total meetings (each meeting over 1.5 hrs):

- Meeting #1: Kickoff and introduction to members and charge
- Meeting #2: Review and discussion projects 1-3
- Meeting #3: Review and discussion of projects 4-6
- Meeting #4: Review and discussion of projects 7-9
- Meeting #5: Review of ratings and responses for all projects

Molecular Microbial Phenotyping Capability (M2PC)

Importance: A - Absolutely central

Readiness: B – Significant challenges prior to construction

Scientific Importance: M2PC has a high potential to contribute to world-leading science in the next decade. It would phenotype vast numbers of microbial isolates providing crucial functional data on those communities from multiple environments, a goal highlighted in the 2017 Grand Challenges Report.

Readiness:

- M2PC will need to develop technical solutions and scientific strategies to enable cultivation of consortia across a vast, diverse biological and environmental (conditional) parameter space.
- M2PC will need to align all the equipment infrastructure and state-of-the-art technologies needed to quickly do genomics, metatranscriptomics, metaproteomics, metabolomics, and secondary metabolites.

Drizzle, Aerosol, and Cloud Observation Chamber (DRACO)

Importance: A - Absolutely central
Readiness: C - Mission not yet fully defined

Scientific Importance: The Subcommittee concurs that the science questions related to drizzle and aerosol processes, especially if studied in the context of turbulence, are important. However, less resolved, high-impact questions regarding ice microphysics may be of higher priority. A comprehensive chamber, including warm and cold cloud processes with turbulence, would be a unique facility, providing DOE with next-generation leadership in laboratory studies of clouds.

Readiness: Mission and technical requirements are not yet fully defined for the elements related to ice microphysics in the presence of turbulence that are suggested here for inclusion. The Subcommittee further advises that research at this facility be integrated closely with modeling and field-based cloud research. Linkages to the proposed phased-array radar are encouraged.

BER Data Center (BDC)

Importance: A - Absolutely central

Readiness: C - Mission not yet fully defined

Scientific Importance: The Subcommittee recognizes the need for a BDC to serve the needs of BER stakeholders whose research activities range in spatial dimensions from atomic to planetary distances and in temporal dimensions between sub-seconds to millennia. The BDC needs to work closely with ASCR to avoid duplications and to take advantage of new infrastructure.

Readiness: The Subcommittee recommends that the following challenges and concerns be addressed: (a) data diversity and challenges of an integrated infrastructure, (b) roles of and impacts on existing resources, (c) expertise and leadership, and (d) possible avenues for technical implementation.

Plant Transformation Capability (PTC)

Importance: A - Absolutely central
Readiness: A - Ready to initiate construction

Scientific importance: The Subcommittee finds that establishment of a Plant Transformation Capability (PTC) is timely and highly desirable. Overall, we find that the PTC will be a unique facility to meet a central need in plant sciences. Currently, there is no existing large-scale facility that addresses the challenges of facile transformation of diverse plant species. In this context, the recent recognition by NSF and USDA of the centrality of plant transformation provides assurance that the PTC will address needs of the broad plant science community.

Readiness: The Subcommittee places the PTC in the category (A) ready to initiate. Organization and priorities for PTC have been defined in a recent workshop. The subcommittee notes that the mission need is clear, and the knowledge trust is available to immediately establish the PTC at one or more DOE facilities to better serve the bioenergy community and address the plant transformation challenges during the CD process.

Bioeconomy Accelerator Facility (BAF)

Importance: B - Important

Readiness: C - Mission not yet fully defined

Scientific Importance: The BAF has an important potential to contribute to world-leading science because of its potential to increase the availability of domestic scale-up facilities, expand capabilities for scale-up to non-standard processes, and to couple scale-up research with research on upstream and downstream processing.

Readiness: This potential is currently largely unready to be realized because of the lack of a clear mission and set of objectives that would distinguish the BAF from other existing facilities. BERAC recommends: i) to clearly define the contributions for such a facility by BETO and BER, and ii) convene a workshop to define the scientific needs for such a facility.

Earth System Modeling and Analysis Center User Facility (ESMAC)

Importance: A - Absolutely central

Readiness: B - Significant challenges prior to construction

Scientific Importance: The Subcommittee finds ESMAC to be absolutely central in its potential to contribute to world-leading science. The DOE Energy Exascale Earth System Model (E3SM) is a world-leading model in its class, both scientifically and computationally. User facilities along the lines of ESMAC are in place elsewhere (Europe, Japan, and, in the US, at the NSF's National Center for Atmospheric Research, NCAR), but ESMAC would be unique in that its foci include human interactions with the Earth system and biological interactions with physical and chemical components of the Earth system. E3SM also uniquely places strong application emphasis on the nation's energy sector.

Readiness: The Subcommittee recommends exploring how ESMAC can complement Earth system modeling activities at NSF, as well as other agencies and internationally. Dedicated computing and analysis at ASCR facilities, which are envisioned to undergo transformative enhancement in response to this charge, should be explored. A community workshop on this topic is encouraged.

EcoPODs and Smart Soil Systems (EcoPaSSS)

Importance: C - Lower priority

Readiness: B - Significant challenges prior to construction

Scientific importance: The Subcommittee has concerns about ECOPASS's uniqueness, its utility to the broad BER community, and its value in informing processes in the field. A major concern is that the proposed equipment is not unique; there are other facilities with similar capabilities. A major goal of EcoPASSS is to bridge laboratory experiments and ecosystem measurements to better understand the impacts of soil-plant-microbe interactions. This goal is perceived as unrealistic in the absence of a stronger link to field studies (maybe linking with BRCs or EMSL) and incorporation of scaling to realistic agro-ecosystem modeling.

Readiness: While this equipment could be purchased immediately, the Subcommittee is concerned that the currently proposed configuration lacks the flexibility that would position EcoPASSS to have a community-wide scientific impact in the 10-year timeframe.

Visual Proteomics Capability (VPC)

Importance: D - Don't know enough yet

Readiness: B - Significant challenges prior to construction

Scientific importance: The concept of spatial or visual proteomics aims to systematically identify the complete protein composition of a cell or its sub-cellular regions, mapping out how protein composition varies spatially within or between cells. The Subcommittee has concluded that, based on its overall analysis, it is too early to start building a VPC.

Readiness: The current objectives for VPC appear to require capabilities beyond current instrumentation and would therefore require a substantial research effort to increase sensitivity.

Phased Array Radar

Importance: A - Absolutely central

Readiness: A - Ready to initiate

Scientific importance: Upgrading DOE's ARM ground-based research radar is absolutely central if DOE is to maintain its world-leading suite of field observational capabilities. The DOE ARM PAR facility would be unique in providing ground-based observations for research studies of cloud systems, especially important to understanding rapidly evolving convective storms.

Readiness: PAR is (A) ready to initiate construction given this technology has already been implemented through NSF and NOAA applications. While the Subcommittee's strong endorsement of PAR on grounds of scientific potential and construction readiness stands, not withstanding the status of the cloud chamber (DRACO) also under consideration, the Subcommittee notes unprecedented opportunities for synergy between laboratory and field studies should both facilities be constructed.

Summary Findings

Project	Importance	Readiness	Notes
M2PC	A - absolutely central	B - significant challenges prior to construction	High potential to contribute to world-leading science in the next decade. Some challenges around cultivating numerous organisms in a useful manner.
DRACO**	A - absolutely central	C - mission not yet fully defined	The rating of "absolutely central" holds true if the scope is broadened to include freezing processes. Ice microphysics requirements are not yet defined.
Data Center*	A - absolutely central	C - mission not yet fully defined	Needed for linking disparate data across BER and to facilitate analysis using new technologies. Better understanding needed of the role of existing resources.
Plant Transformation Capability (PTC)	A - absolutely central	A - ready to initiate	PTC will be a unique facility that meets a central need in plant sciences. Organization and priorities for PTC have been defined in a recent workshop
Bioecnomy Accelerator (BAF)	B - important	C - mission not yet fully defined	Can potentially increase the availability of domestic scale-up facilities. The overall need and fit within other closely-related centers was not clear. Workshop needed to scope this out more.
Earth System Modeling and Analysis Center (ESMAC)*	A - absolutely central	B - significant challenges prior to construction	The U.S. is behind in having an Earth system modeling facility. A DOE facility would be unique among related national Centers. A number of questions remain that could be addressed in a workshop on this topic.
ECOPOD	C - lower priority	B - significant challenges prior to construction	Scientific contributions overall and to the larger BER community are not evident.
Visual Proteomics	D - don't know	B - significant challenges prior to construction	Concept is relatively new and may not be ready to address stated research objectives.
Phased Array Radar (PAR)**	A - absolutely central	A - ready to initiate	The upgrade to PAR is important and valuable for the ARM User Facility, and for users of the facility. PAR is operational elsewhere so it is ready to initiate.

*Potentially strong links to proposed ASCR projects.
**Potential synergy between DRACO and PAR.