

March 31, 2010



Dr. W.F. Brinkman
Director, Office of Science
U.S. Department of Energy
Washington, DC, 20585

Transmittal of the Preliminary Report of the ASCAC Subcommittee on Exascale Computing

Dear Dr. Brinkman,

Attached are preliminary comments from the Advanced Scientific Computing Advisory Committee (ASCAC) on Opportunities and Challenges of Exascale Computing. These comments are primarily in the form of a presentation slides from the ASCAC subcommittee chaired by Dr. Robert Rosner of the University of Chicago. These slides were presented by Dr. Rosner at our meeting on March 30, 2010 and publically discussed and accepted by the full committee on March 31, 2010.

The subcommittee, whose members are indicated on the first page of the attachment, worked together through conference calls, emails, and at a two day meeting in March, 2010. They reviewed all of the then available materials and reports from Department of Energy sponsored exascale workshops and meetings. They considered the challenges and opportunities with primary impact in the Office of Science as well as those impacting DOE more broadly.

Key observations include:

- Exascale computing offers transformational opportunities for some key science and engineering areas, particularly by establishing validated predictive capabilities essential for design and for game changing scientific and technical discovery.
- The application workshop results allow us to identify some applications where we can confidently predict transformational impacts of exascale computing as well as many applications where significant impact is likely.
- The cross-cutting workshops on technology/architecture and on applied math/algorithms demonstrate that the path to exascale requires algorithms, applied mathematics, and mathematical models addressed through discussions with computational scientists, applications developers, and experts in system architecture, system software and tools, and programming frameworks, with the goal of defining an R&D agenda for exascale. The concept of co-design may offer a mechanism to effectively address these linked challenges.
- There is a fundamental transformation of computing taking place with the emergence of new families of processor chips with large degrees of concurrency – an exascale initiative can leverage this to the great advantage of scientific computing and DOE missions.
- The time to start on the path to exascale is now, as there is a significant opportunity cost of delay.
- The magnitude of the changes in programming models, software infrastructure, algorithms and applied mathematics brought about by the transition to peta/exascale architectures will produce tremendous challenges and needs in the area of education and training.

In our continuing discussions moving toward the final report, we expect the subcommittee and ASCAC will consider the following:

- Include the remaining application areas (whose workshop reports were outstanding, for example) in the analysis.
- Further identify and elaborate on case studies where advanced computing has been transformative as we moved from giga- to tera- to peta- scales.
- Identify strategies that ASCR can use to address the challenges of exascale, including:
 - the role of basic applied mathematics, computer science, and algorithmic research;
 - lessons learned from NNSA-ASC;
 - supports needed for co-design including strategies for industry engagement;
 - the benefits of a more holistic approach that includes support for experiments designed to improve simulation capability; and
 - technology transfer strategies/partnerships with private sector on application side to ensure that the potential benefits for the energy sector are realized.

The exascale efforts being considered are significant and transformative. Undertaking and succeeding in this reinforces that “it’s still possible to do big things in America.”

Sincerely,



Dr. Roscoe C. Giles
Chair, ASCAC
Center for Computational Science
Boston University

CC: Dr, Steven E. Koonin
Under Secretary for Science
U.S. Department of Energy

Dr. Michael Strayer
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Dr. Christine Chalk,
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