Advanced Scientific Computing Research (ASCR)

ASCR Mission: To discover, develop, and deploy computational and networking capabilities to analyze, model, simulate, and predict complex phenomena relevant to DOE.

Priorities:

- Develop mathematical descriptions, models, methods, and algorithms to understand complex systems across wide spatial and temporal scales
- Develop the underlying understanding and software to make effective use of computers at extreme scales and to transform extreme-scale data into scientific insight
- Deliver forefront computational and networking capabilities to extend the frontiers of science
- Support mathematical and computational partnerships to advance key DOE & SC missions
- Develop networking and collaboration tools and facilities that enable scientists worldwide to work together

Program Planning Factors for FY 2010:

- Significant effort will be spent capitalizing on recent advances in computer science through cross-disciplinary research partnerships, and long term research efforts for next generation computer architectures.
- Scientific Workshops and External Reviews
  - *Cyber Security Research Needs for Open Science* (2007)
  - Workshop series on science challenges and the potential role of extreme scale computing (2008-2009)
  - Committee of Visitors - Computer Science (2009)
- National Research Council report, *The Potential Impact of High End Capability Computing in Four Illustrative Fields of Science and Engineering* (2008)
- Interagency coordination through the National Information Technology Research and Development (NITRD) Program
- 2009 Recovery Act enhancements

ASCR FY 2010 Highlights

Research:

- **Applied Mathematics Research** continues to focus on advancing techniques and algorithms that enable simulations at extreme scales, understanding massive data sets, and cybersecurity. 20% of the recently announced SIAM fellows supported by ASCR.
- **Computer Science Research** maintains its focus on developing operating systems, tools, programming models, and data management for extreme scale computing with applications across science. A new effort for FY 2010 will support research in advanced computer architectures.
- Support for **Computational Partnerships** continues with **Scientific Discovery through Advance Computing (SciDAC)** Centers for Enabling Technologies, SciDAC Institutes, and Science Application Partnerships as successful means of increasing the impact of computational science across the disciplines – including the 2008 Gordon Bell Special Prize for Algorithms team.
- **Next Generation Networking Research for Science** will initiate new research efforts to focus on developing technologies to support research and education networks such as ESnet.

Facilities:

- **Leadership Computing Facilities (LCFs)**—the most capable machines available to open science -- receive continued support for operations and site preparation for upgrades.
  - Oak Ridge LCF multicore Cray Baker system will provide 1.64 petaflop capability
  - Argonne LCF IBM Blue Gene/P system will provide 556 teraflop capability
- The **National Energy Research Scientific Computing (NERSC)** facility will be upgraded to a capacity of approximately one petaflop to meet ever growing demand from the Office of Science researchers.
- **ESnet** will begin to deliver 100-400 gigabits per second connections to the Office of Science Laboratories in FY 2010 through support for operations and upgrades. ESnet was recently recognized by an Excellence.gov award as the best in government for Effectively Leveraging Technology.
- **Research and Evaluation** prototypes will continue to support development of the next generation of leadership computing systems.

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(FY 2008=$341.8M; FY 2009=$368.8M; **FY 2010=$409.0M**)

- Research develops advanced algorithms to describe, model and simulate physical and biological systems; deepens our understanding of software for high-performance computers; advances capabilities of scientific networks; and supports the development of computational science as an intrinsic tool for scientific discovery.
  - Applied Mathematics - Critical research efforts in numerical methods, mathematics of large data sets, optimization, cyber security, and multiscale and multiphysics applications continue to generate new ideas and solutions for the advancement of computing research.
    (FY 2008=$32.1M; FY2009=$40.2M; FY 2010=$44.9M)
  - Computer Science - Research aimed at modernizing computational science tools and techniques in preparation for the next generation infrastructure continue to receive support through research grants and new efforts in advanced computing architectures.
    (FY 2008=$24.1; FY2009=$33.6M; FY 2010=$46.8M)
  - Computational Partnerships - SciDAC Centers for Enabling Technologies, SciDAC Institutes for training the next generation of experts, and SciDAC Applied Partnerships continue to receive support for increasing the impact of computational science across the disciplines.
    (FY2008=$54.1M; FY 2009=$52.1M; FY 2010=$53.2M)
  - Next Generation Networking Research for Science - Support continues for research in distributed systems software and networking technologies aimed at meeting growing demands of large-scale, collaborative scientific research efforts. New efforts focus on developing technologies to support ESnet.
    (FY 2008=$7.6M; FY 2009=$14.3M; FY 2010=$14.3M)

- Facility Operations supports operation of HPC facilities & networks and the development of prototypes & testbeds for next generation technologies.
  - High Performance Production Computing will support the operation of NERSC for nearly 3,100 Office of Science supported users.
    (FY2008=$56.7M; FY 2009=$54.8M; FY 2010=$55.0M)
  - Leadership Computing Facilities (LCFs) will continue to provide open access to high performance resources for the scientific community through the INCITE program. The Argonne LCF will operate a 500 teraflop IBM Blue Gene system & the Oak Ridge LCF will operate a 1.64 petaflop Cray system.
    (FY 2008=$114.1M; FY 2009=$115.0M; FY 2010=$130.0M)
  - Research and Evaluation Prototypes will continue to support the DARPA HPCS partnership's development of the Cray architecture and, in partnership with NNSA and IBM, support the development of the Blue Gene Q architecture.
    (FY 2008=$25.3M; FY 2009=$23.9M; FY 2010=$23.9M)
  - High Performance Network Facilities &Testbeds will support continued operations of ESnet and related testbeds including continued upgrades to optical technologies that will begin to deliver 100-400Gbps connectivity. The increase in bandwidth is critical to meeting the growing requirements for Department applications and facilities
    (FY 2008=$27.8M; FY 2009=$25.0M; FY 2010=$29.9M)

- All other
  - SBIR/STTR (FY 2008=$9.4-included in program budget; FY 2009=$10.0M; FY 2010=$11.0M)