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Advanced Scientific Computing Advisory Committee Meeting

FY 2009 Budget Request for the Office of Science and Perspectives

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Under Secretary for Science

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Setting the Nation's Priorities

"To build a future of energy security, we must trust in the creative genius of American researchers and entrepreneurs and empower them to pioneer a new generation of clean energy technology. . .

So I ask Congress to double Federal support for critical basic research in the physical sciences and ensure America remains the most dynamic nation on Earth."

President George W. Bush
State of the Union Address
January 28, 2008

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The Status of ASCR

- ASCR is in a challenging and exciting period
  - DOE operates a number of the worlds fastest computers that have been extraordinarily productive and have advanced many fields.
  - As high performance computing takes its place at the "third pillar" for scientific discovery, the demand for cycles is growing even faster than our aggressive build out of leadership computing.
  - As we look ahead to the next generation of computing architectures we see significant challenges for scientific applications that will be the focus of several new research initiatives.

- The FY 2008 Omnibus Bill provided nearly all of the President's request for ASCR:
  - Funds LCFs, NERSC, ESnet, SciDAC, and Core Research efforts
  - General Reduction cuts ~$2M from program.

- A few surprises:
  - Additional funds provided to "maintain cost and schedule baselines for OLCF"
  - Additional funds provided for ASCR to assume responsibility for the entire DOE commitment to the DARPA HPCS activity (including ~$6.5M for NNSA).
  - Congressional direction and additional funds provided for joint ASCR-NNSA Institute for Advanced Architectures and Algorithms with Centers of Excellence at Sandia and Oak Ridge.

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FY 2009 Budget Request to Congress
(dollars in thousands)

	FY 2007 Approp.	FY 2008 Request	FY 2008 Approp.	FY 2009 Request to Congress	FY 2009 Request to Congress vs. FY 2008 Approp.	
Basic Energy Sciences	1,221,380	1,498,497	1,269,902	1,568,160	+298,258	+23.5%
Advanced Scientific Computing Research	275,734	340,198	351,173	368,820	+17,647	+5.0%
Biological and Environmental Research	480,104	531,897	544,397	568,540	+24,143	+4.4%
High Energy Physics	732,434	782,238	689,331	804,960	+115,629	+16.8%
Nuclear Physics	412,330	471,319	432,726	510,080	+77,354	+17.9%
Fusion Energy Sciences	311,664	427,850	286,548	493,050	+206,502	+72.1%
Science Laboratories Infrastructure	41,986	78,956	66,861	110,260	+43,399	+64.9%
Science Program Direction	166,469	184,934	177,779	203,913	+26,134	+14.7%
Workforce Dev. for Teachers & Scientists	7,952	11,000	8,044	13,583	+5,539	+68.9%
Safeguards and Security (gross)	75,830	76,592	75,946	80,603	+4,657	+6.1%
SBIR/STTR (SC funding)	86,936	——	——	——	——	——
Subtotal, Office of Science	3,812,819	4,403,481	3,902,707	4,721,969	+819,262	+21.0%
Adjustments*	23,794	-5,605	70,435	——	-70,435	——
Total, Office of Science	3,836,613	4,397,876	3,973,142	4,721,969	+748,827	+18.8%

* Adjustments include SBIR/STTR funding transferred from other DOE offices (FY 2007 only), a charge to reimbursable customers for their share of safeguards and security costs (FY 2007 and FY 2008), Congressionally-directed projects and a rescission of a prior year Congressionally-directed project (FY 2008 only), and offsets for the use of prior year balances to fund current year activities (FY 2007 and FY 2008).

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Advanced Scientific Computing Research (ASCR)

(FY 2009=$368.8M)

Research in applied mathematics and computer science. (FY 2007=$59.7M; FY 2008=$77.4M; **FY 2009=$93.2M**)

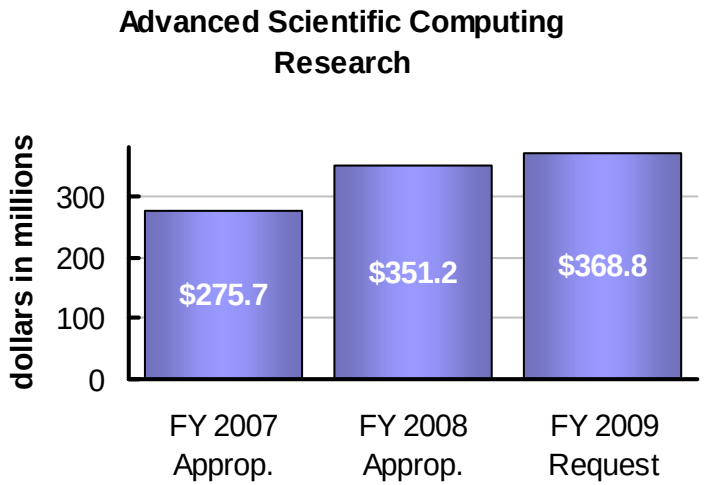
- Support long-term research that underpins: the development of advanced algorithms to describe, model & simulate physical systems; effective utilization of high-performance computers; advanced networks.
- Develop joint Applied Mathematics-Computer Science Institute to focus on the challenges of computing at extreme scales that blur the boundaries between these disciplines.
- Provide direct support for science application "leading edge developers" willing to take on the risks of working with new and emerging languages and tools.
- Support Small Business Innovation Research.

Scientific Discovery through Advanced Computing (SciDAC). (FY 2007=$47.4M; FY 2008=$56.3M; **FY 2009=$58.1M**)

- Advances in high-end computation and networking technology and innovative algorithms and software are exploited as intrinsic tools for scientific discovery.
- Scientific Application Partnerships, Centers for Enabling Technologies, university based SciDAC Institutes, and a SciDAC Outreach Center are supported in FY 2009.

High-performance computing and network facilities and testbeds. (FY 2007=$168.6M; FY 2008=$217.5M; **FY 2009=$217.5M**)

- Deliver Leadership Computing for Science
  - Deliver one petaflop computing capability at Oak Ridge Leadership Computing Facility for Science applications.
  - Deliver 500 teraflop computing capability at Argonne Leadership Computing Facility with low power requirements.
- Deliver high-performance production computing at NERSC.
- Deliver the promise of optical networks for DOE's science research missions through ESnet.



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The FY 2009 Budget Request: A New Era for Science

High Performance Computation

High Performance Computing is the "third pillar" for scientific discovery, along with experiment and theory

New achievements in High Performance Computing are opening new frontiers in science and industrial innovation.

- **Leadership Computing Facilities (LCF)** expanding capabilities for breakthrough discoveries – moving to petascale.
  - **Oak Ridge LCF** ($85.0M) is reaching one petaflop computing capability – a 100X increase from the Office of Science's capability in 2004.
  - **Argonne LCF** ($30.0M) reaches 500 teraflop computing capability.
- **National Energy Research Scientific Computing (NERCS) Center** ($54.8M), at least 120 teraflops, introduces researchers to high performance computing for science applications.
- **ESnet ($25.0M)** high speed optical networks are connecting laboratories and universities to leadership computing facilities and allow rapid transfer of large scientific datasets.

Innovative and Novel Computation Impact on Theory and Experiment program is successfully applying the "third pillar" for scientific discovery to expand the frontiers of science

- Universities and laboratory researchers are advancing the science mission with simulation in areas like systems biology, chemical catalysis and climate modeling
- Enabling industry to dramatically reduce the time for product and technology development

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The Scientific Opportunities for ASCR

- Leadership class computing at the exascale is expected around 2023 but might be accelerated by five years (~2018) through targeted investments.
- Significant challenges arise in accomplishing exascale computing, in areas that include architecture, scale, power, reliability, I/O, storage, cost, packaging, and utilization.
- Also required will be a tight coupling to a selected set of science communities and the associated applied mathematics R&D.
- Three town hall meetings examined a range of applications that would be materially transformed by the availability of exascale systems. The report highlights several significant opportunities in:
  - energy, climate, socioeconomics, biology, and astrophysics.
- Computational science and engineering opportunities in energy are wide and deep and have an enormous potential impact on advancing energy technology and fundamental science.
- **www.sc.doe.gov/ascr/ProgramDocuments/TownHall.pdf**

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The Plan for ASCR

- **Deliver Petascale Computing for Science Applications**
  - Continue to make the Leadership Computing Facilities available to the very best science through INCITE.
  - Continue to work with Pioneer Applications to deliver scientific results from day one.
- **Keep DOE Computational Science at the Forefront**
  - Continue to nurture applications critical to DOE missions through SciDAC.
  - Provide direct support for "bleeding-edge" research groups willing to take on the risk of working with emerging languages and operating systems.
  - Foster innovative research at the ever blurring boundary between Applied Mathematics and Computer Science.
- **The Promise of Exascale**
  - Work with key science applications to identify opportunities for new research areas only possible through exascale computing.
  - Support innovative research on advanced architectures and algorithms that accelerates the development of hardware and software that is well suited to exascale computational science.

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Our Challenge

- The very large percentage increase between the essentially flat funding for the DOE Office of Science in FY2008 and the FY2009 President's Request will be an attractive target.
  - We could easily, again, become a "donor" program. This is true for all three American Competitiveness Initiative agencies.

- Compounding the danger is the widespread attitude that the proposed increases for the physical sciences under the ACI and America COMPETES act are "a done deal".

- There is the possibility we may see a "three-peat" and a perpetuation of flat-to-declining budget trajectories.

- If we are to avoid this scenario we need to actively and publicly make the case for LONG-TERM basic research rather than short-term applied research.

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The Office of Science Challenge

The Past and Present:

- The President's Request for SC for FY 2007 was $4,102M.
  The Appropriation for SC for FY 2007 was $3,813M. Δ = - $289M.
- The President's Request for SC for FY 2008 was $4,404M.
  The Appropriation for SC for FY 2008 was $3,903M. Δ = - $501M.
- The President's Request for SC for FY 2009 is $4,722M.
  The Appropriation for SC for FY 2009 in ?. Δ = ± ? Σ = - $790M ± ?.

The Future?

- The President's Request for FY 2009 is $819M more that the FY 2008 appropriation, a huge dollar increase. SC could easily, again, become a "donor" program. If we are to avoid this scenario we need to actively and publicly make the case for LONG-TERM basic research rather than short-term applied research.

It is now up to us to make the case.

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Looking Forward

The President's Budget Request for FY2009 remains a vote of confidence for the physical sciences, expressing unprecedented support:

"To keep America competitive into the future, we must trust in the skill of our scientists and engineers and empower them to pursue the breakthroughs of tomorrow . . . This funding is essential to keeping our scientific edge."

President George W. Bush
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