U.S. DEPARTMENT OF ENERGY
INCITE
LEADERSHIP COMPUTING

2011 INCITE Process and Awards

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ASCAC

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What is INCITE?

INCITE: Innovative and Novel Computational Impact on Theory and Experiment

Provides awards to academic, government, and industry organizations worldwide needing large allocations of computer time, supporting resources, and data storage to pursue transformational advances in science and technology

INCITE is jointly run by the ALCF and OLCF leadership teams, managed by Julia White

Announcements

Oak Ridge National Laboratory

Argonne National Laboratory

INCITE mission goals

INCITE seeks projects that meet specific criteria	
1. Impact criterion	**2. Computational leadership criteria**
• High-impact science and engineering with specific objectives	• Computationally intensive runs that cannot be done anywhere else (typically use 20% or more of the LCF system for production jobs) • Campaign that requires tens of millions of CPU hours • Computations that are efficient on INCITE's LCF systems

Seismic simulations

Modeling the next big shakeup

Key challenges

- A team led by Southern California Earthquake Center (SCEC) director Thomas Jordan is using INCITE resources to simulate a magnitude-8 quake and assess its impact on the Southern California region: Home to 20 million people—about one in 15 Americans

Key benefits

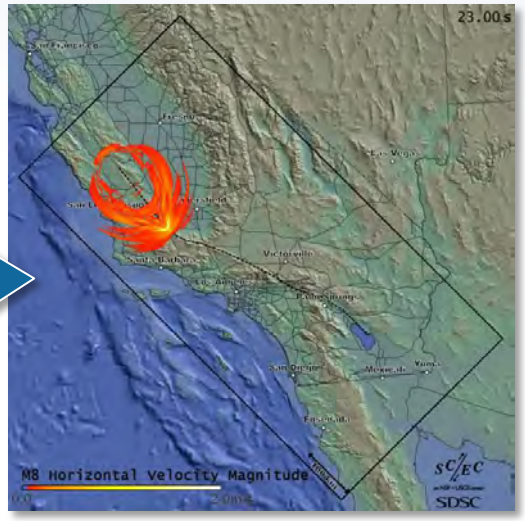
- Data and conclusions will be valuable to seismologists as well as building designers and emergency planners

Computing solutions

- Frequencies of seismic waves calculated at 2 Hz
- Simulate rupture as it travels along the fault and the earthquake waves and resultant shaking as they spread through the region
- M8 simulation compares well with data averaged from many real earthquakes, in particular on rock sites

"The things we learn about earthquakes here should be applicable to earthquakes around the world."

Southern California Earthquake Center information technology architect Phil Maechling



The Magnitude-8 simulation shows a Mach Cone—the seismic equivalent of a sonic boom—as the earthquake rupture proceeds to the southeast.

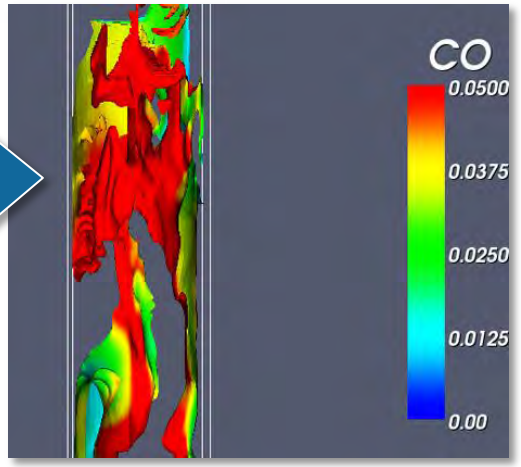
Efficient coal technology

Building gasifiers via simulation

Key challenges	Key benefits	Computing solutions
• Conduct high-reliability simulations of a coal gasifier to understand and manipulate the dense, reactive gas-solid system • Demonstrate the impact of simulation on reducing the cost and time required to develop the zero-emissions power plants of the future	• Gasification breaks down carbon-based materials into CO and H_2 by means of thermochemistry rather than burning • Sequestration of 90% of the carbon from coal with minimal impact to the cost of electricity	• Creation of several high-resolution simulations to provide feedback on the design of a commercial-scale gasifier system for NETL's Clean Coal Power Initiative, a cost-shared venture by the government and industry

"This ability to finely resolve relevant structures inside a dense, reactive gas-solid system is not only unique, but also necessary to accelerate the commercial deployment of advanced gasification technology."

Chris Guenther, research scientist in NETL's Computational Science Division and project leader



Simulation of a coal jet region

Image courtesy of Chris Guenther, National Energy Technology Laboratory (NETL)

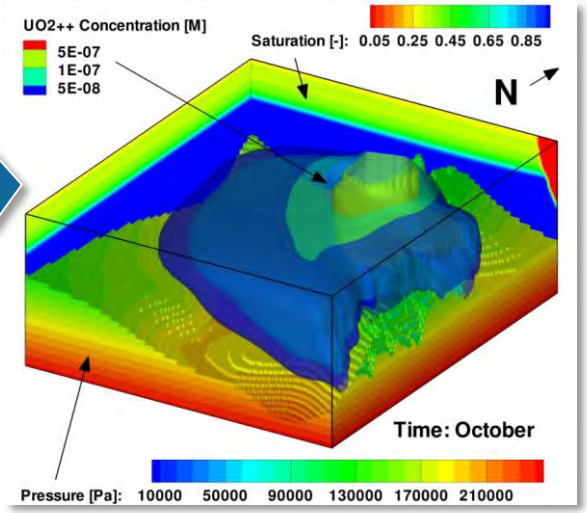
Groundwater remediation

Assisting Cleanup of Decades-Old Nuclear Waste

Key challenges	Key benefits	Computing solutions
• Build a 3D model of an underground uranium waste plume at the Hanford Site's 300 Area • The chemical properties of the plume require more than 28 million degrees of freedom—the number of actions constituents might take as the plume migrates	• Aid stakeholders in weighing options for contaminant remediation • Provide more accurate assessment of amount of uranium leaching into the Columbia River (~55–110 lbs per year)	• The team calculated the uranium loss from the plume and the flux into the Columbia River at 1 hour intervals, which allowed construction of realistic models of the river's interaction with the migrating plume

"And what we learn from this site we should be able to apply to other sites as well, not only at Hanford, but also around the country—at Oak Ridge and other areas dealing with contamination."

Peter C. Lichtner,
Los Alamos National Laboratory



Peter Lichtner and colleagues run the PFLOTRAN code on the Jaguar supercomputer to model the distribution of uranium at the Hanford Site's 300 Area

Image courtesy
Peter C. Lichtner, LANL

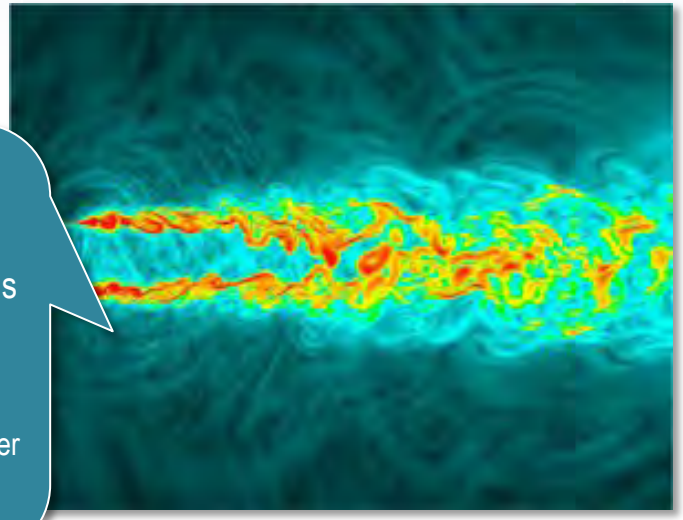
Next-generation energy and propulsion

First proof-of-concept aero and acoustic large-eddy simulation (LES) calculation completed

Key challenges	Key benefits	Computing solutions
• Reduce airfoil trailing edge noise—a key component in wind turbine noise generation • Tackle the yield-limiting noise barrier for wind turbines using simulation-based aeroacoustics via large-scale computing	• Quieter and larger blades and a significant increase in the energy yields possible from the wind portion of the world's renewable portfolio	• Comparisons with available experimental data show that the LES predictions are successful in predicting key flow phenomena

"As this technology develops, it will accelerate GE's ability to design quieter and larger blades and significantly increase the energy yields possible from the wind portion of the world's renewable portfolio."

Dr. Gary Leonard, Global Technology Leader
Energy and Propulsion Technologies
GE Global Research



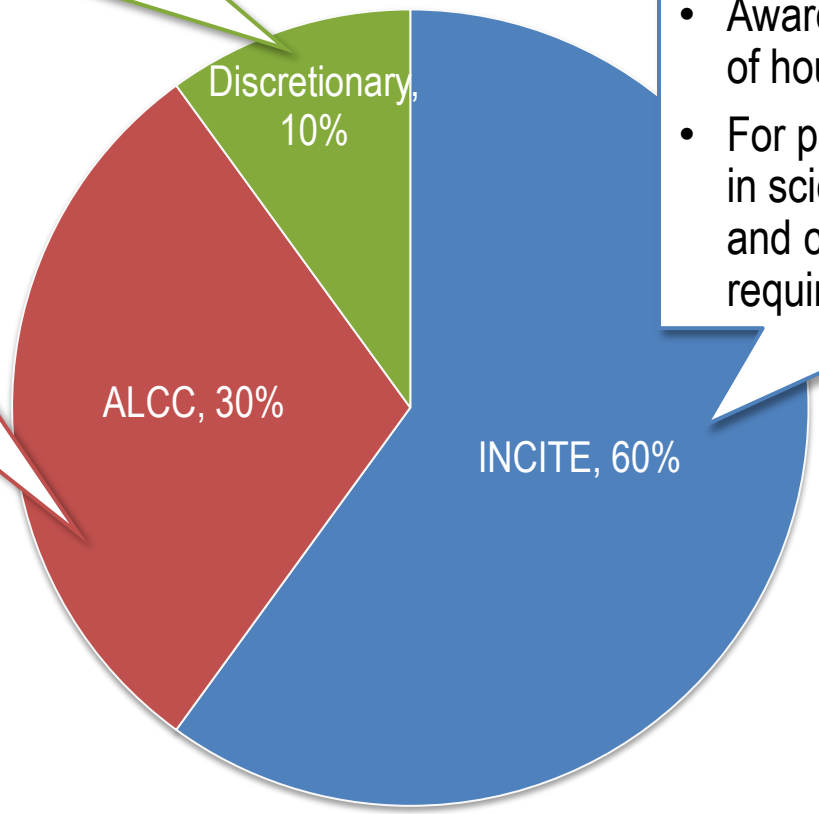
Reducing aerodynamic noise is critical to the viability of next-generation "green" low-carbon/greenhouse gas emission energy systems (e.g., wind turbines)

LCF allocation programs
More than 2.7 billion processor hours

- Proposals considered year-round
- Award up to millions of hours

- Annual call for proposals
- Award tens of millions of hours per project
- For projects of high impact in science, engineering, and computer science that require leadership systems

- Allocated by the ASCR office, consistent with Office of Science mission areas



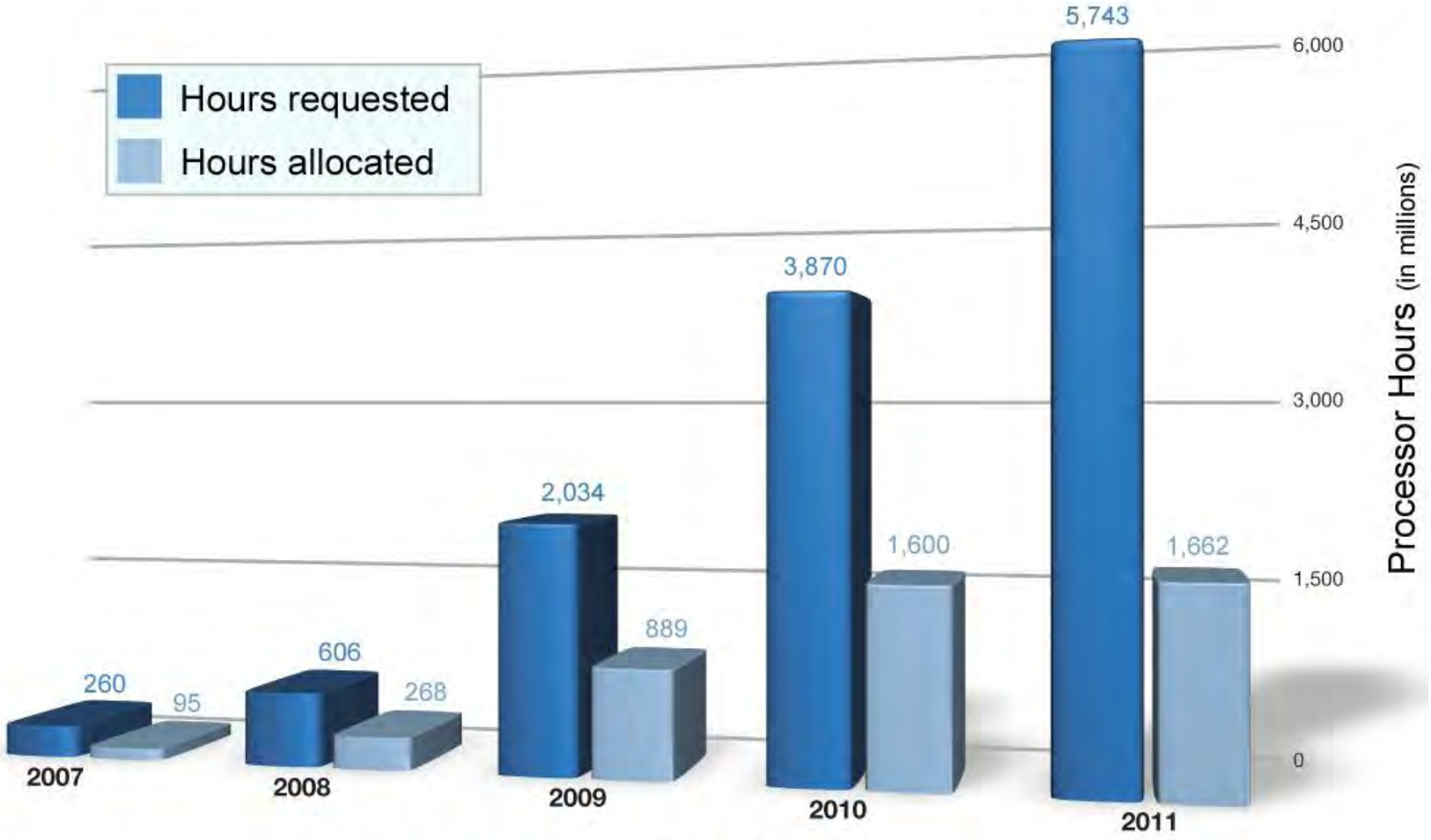
INCITE is open to researchers worldwide from academic, government, and industry organizations

Advancing the state of the art across a range of disciplines

- Accelerator physics
- Astrophysics
- Bioenergy
- Chemical sciences
- Computer Science
- Engineering
- Climate research
- Environmental science
- Life sciences
- Materials science
- Fusion energy
- Nuclear physics

- No designated number of hours for a particular science area
- INCITE looks at all recommendations, focusing on potential for scientific or technological impact and ability to effectively use LCF systems

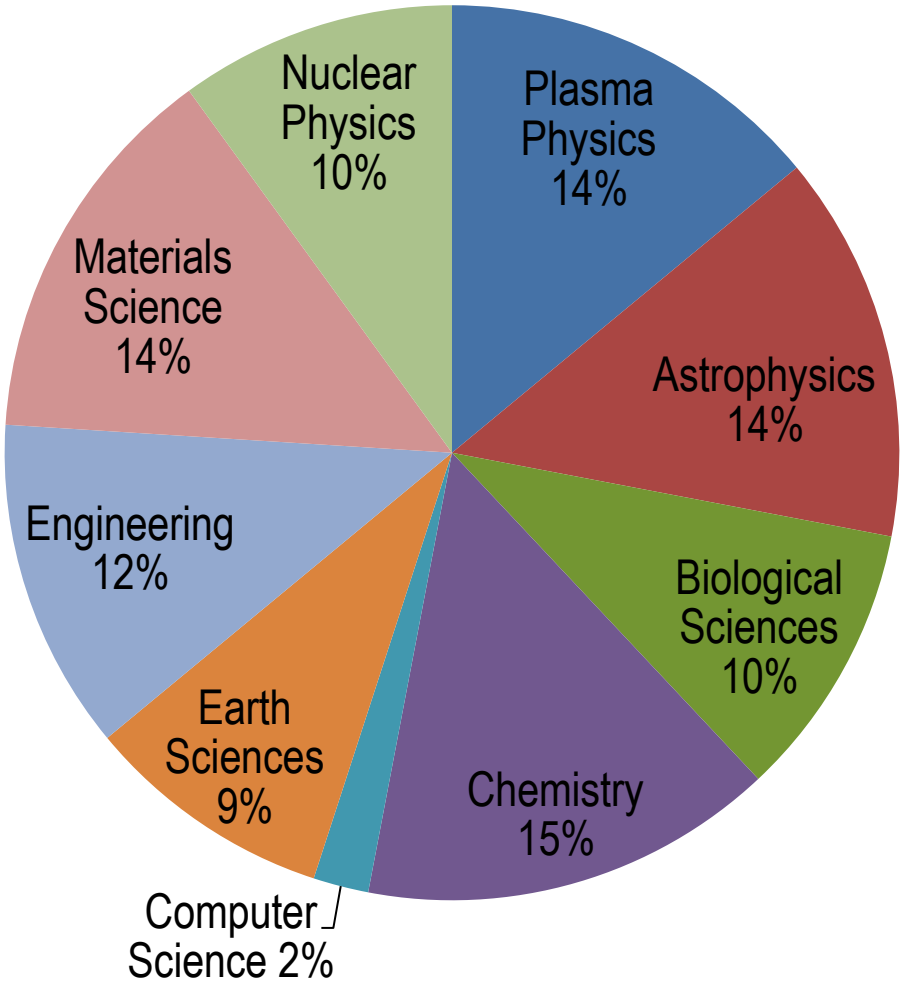
Growing demand for INCITE hours



INCITE Demand

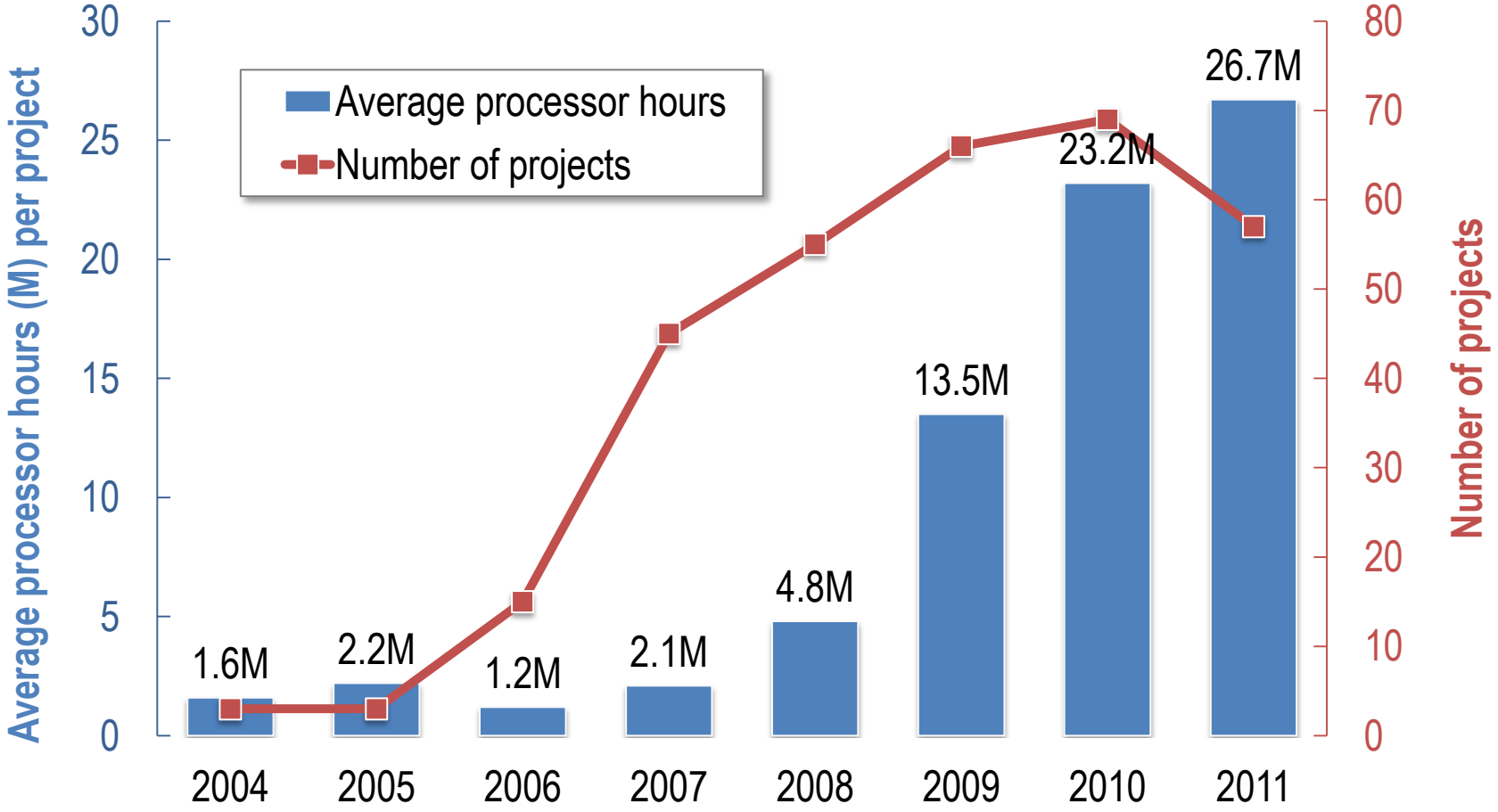
2011 INCITE awards 1.7B hours:

32 new projects and 25 renewal projects awarded
33% of new submittals and 89% of renewals accepted



Percentage of total 2011 INCITE hours by domain

Trends in INCITE awards



In 2011 met the goal to decrease the number of projects, increase the per project award size

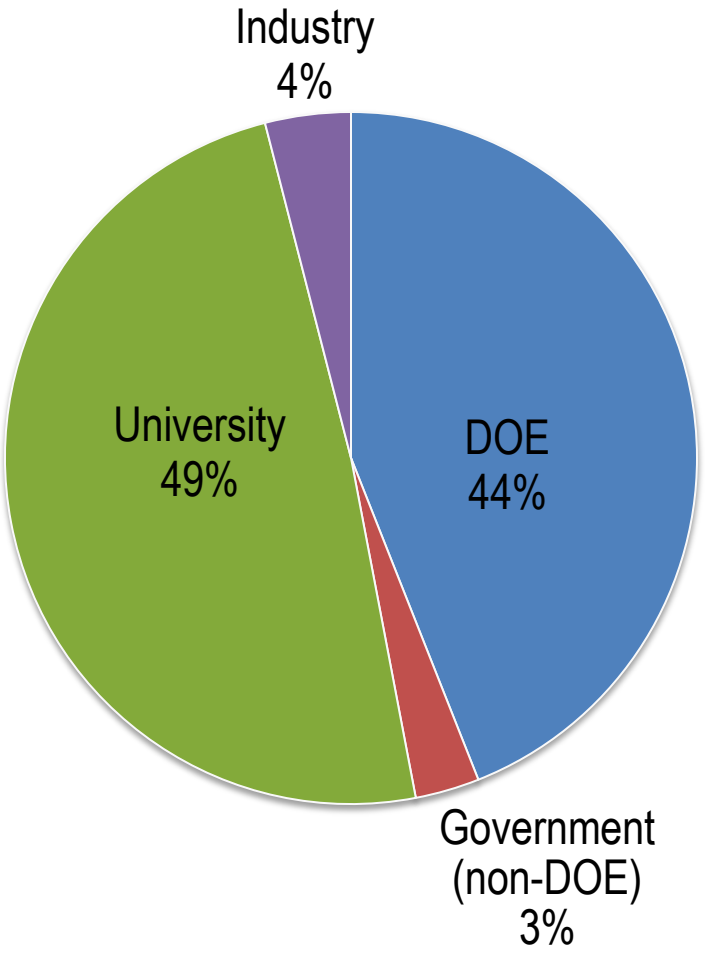
Project number decreased, and average and median increased

	Intrepid		Jaguar	
	INCITE 2010	**INCITE 2011**	INCITE 2010	**INCITE 2011**
Number projects	35	**30** ↓	45	**32** ↓
Average Project	18.5M	**24.4M** ↑	21.1M	**29M** ↑
Median Project	10M	**16.5M**	18M	**20M**

2011 award decisions in keeping with 2008 ASCAC Committee of Visitors Recommendations

- Limit the total number of INCITE awards
- Establish a standard for renewals and reallocate the time if the standard is not met

2011 INCITE project demographics by PI affiliation



2011 INCITE project collaborations

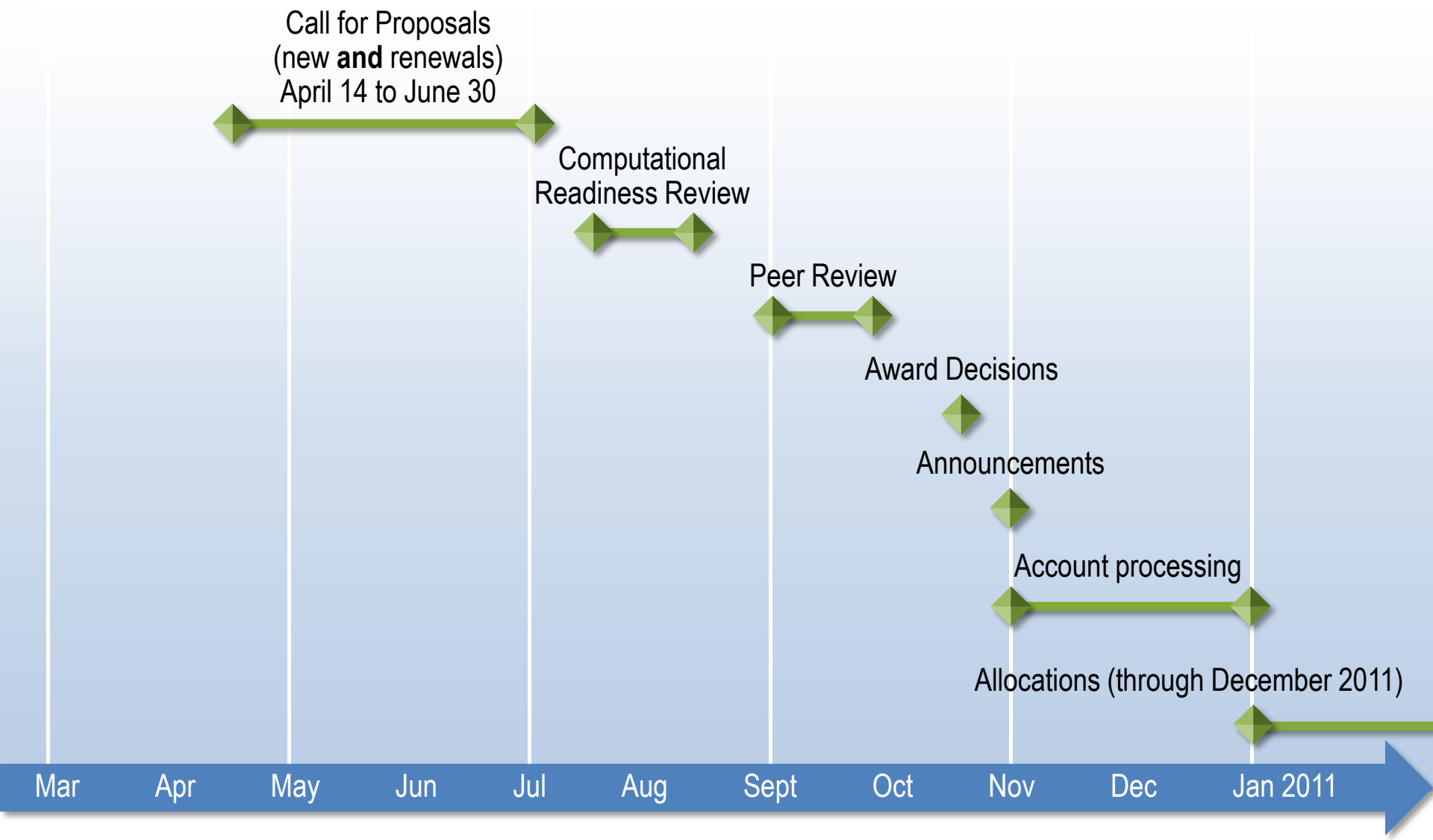
PI/co-PI affiliations show collaborative teaming of the awarded projects*

	DOE	University	Government	Industry	International
DOE	**11**	15	1	0	2
University		**13**	0	3	2
Government			**1**	0	2
Industry				**2**	0
International					**2**

*Table lists number of proposals having at least one PI or co-PI at each affiliation (ex. DOE-University)

University-DOE-Industry	2
University-DOE-International	1

2011 INCITE timeline



Twofold review process

	New proposal assessment	Renewal assessment
1 Peer review: INCITE panels	• Scientific and/or technical merit • Appropriateness of proposal method, milestones given • Team qualifications • Reasonableness of requested resources	• Change in scope • Met scientific milestones • On track to meet future milestones
2 Computational readiness review: LCF centers	• Appropriateness for requested resources and computational approach • Technical readiness	• Met technical/ computational milestones • On track to meet future milestones

Awards Committee

The INCITE Awards Committee, composed of the LCF management teams, makes selections based on rankings and recommendations by the **peer-review panel**.

The **readiness ratings** are used to determine the capability of the project to effectively use the selected system and are based on proficiency shown through benchmarking data and/or proposed development plans.

2011 INCITE process achievements

All goals outlined at ASCAC last year have been done

- Post the reviewer questions with the call for proposals to increase transparency of assessment process for proposal authors
  - Recommended by 2008 Committee of Visitors
- Build review panel earlier in the year
- Identify potential opportunities for making referrals from INCITE to ERCAP
- Reassess and potentially redesign web-based form for proposal submittal
  - Increase ease of use
  - Accommodate recent and projected program growth
- Build relationships with other centers whose users have science challenges that would benefit from the scale of the INCITE resources

2011 INCITE peer-review panels

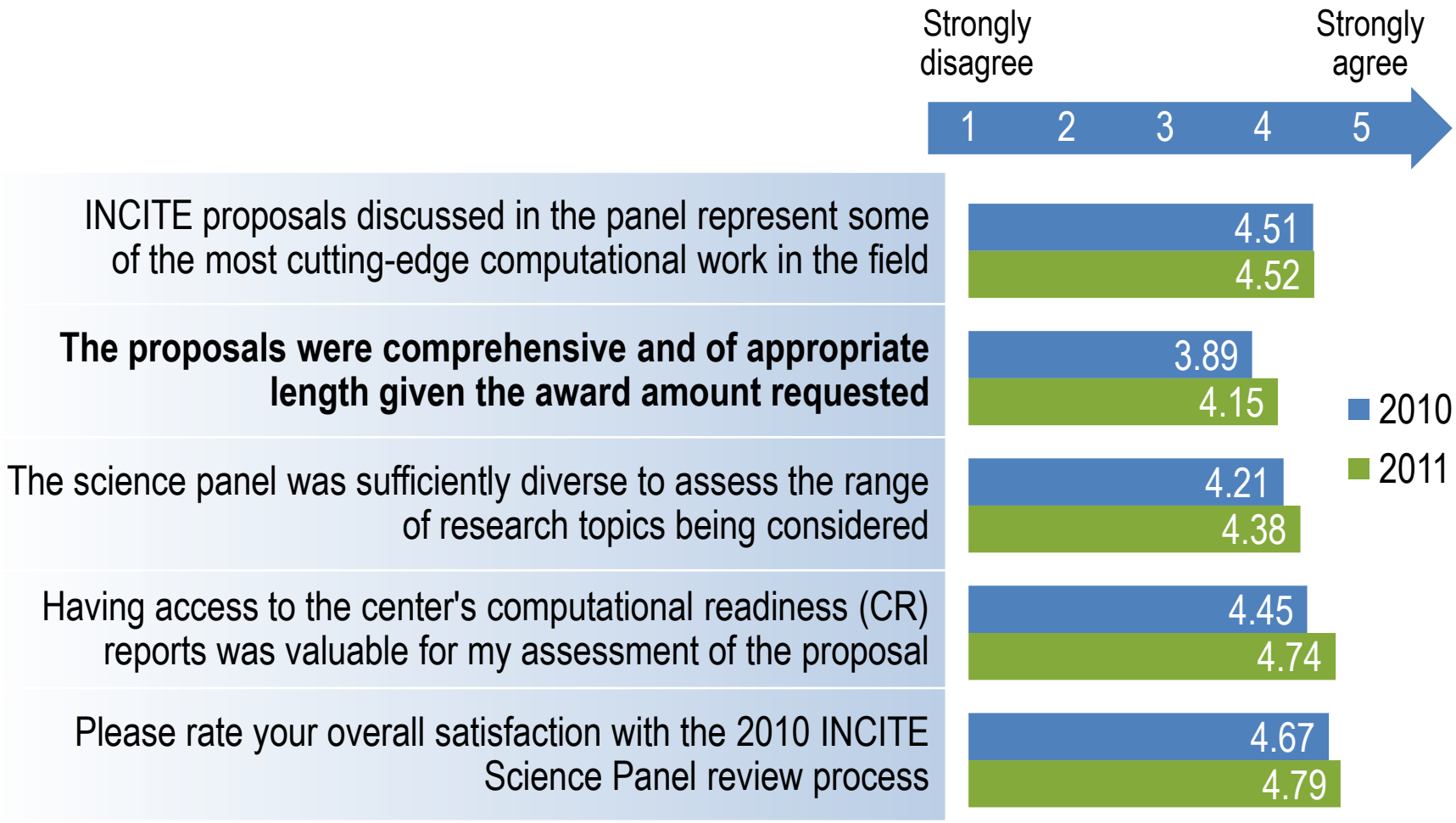
66 researchers participated in the 2011 INCITE panel review.

- More than 50% are society or laboratory fellows, department chairs or heads, or center directors
- 15% from Europe or Canada
- Roughly 50% participated in 2010 INCITE review

Reviews took place the third week in September 2010 in Rockville, MD. Four reviewers provided mail-in reports.

Panel questionnaire

Response rate 94% of panel reviewers at Rockville, Maryland



Building relationships with other centers and programs

- INCITE manager met during ISC'10 BoF with representatives from several European centers
- Management of other centers/programs participated in 2011 INCITE peer-review panels
- INCITE manager attended 2010 TeraGrid TRAC allocation
- Attendance at March 21, 2011 webinar by Italy and Australia center management

2012 INCITE process goals

- Reassess and redesign web-based form for **renewal** submittal
  - Increase ease of use, standardization
  - Emphasize science achievements
- Set expectations for anticipated future HPC systems at the LCFs
- Continue to expand relationships with other centers and programs

2012 Call for Proposals:
April 13 to June 30, 2011

Contacts

For details about the INCITE program:

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For details about the centers:

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