Project Status Report

High End Computing Capability
Strategic Capabilities Assets Program

July 10, 2013

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New SGI System Selected to Augment Pleiades Supercomputer

- A team of high-end computing experts at NASA Ames selected SGI's next-generation ICE X system to augment NASA's HECC supercomputer environment.
  - The new system comprises 46 racks, each with 72 nodes containing two Intel Xeon E5-2680V2 (Ivy Bridge) processors;
  - The Ivy Bridge racks will replace the supercomputer's 64 aging Intel Xeon E5472 (Harpertown) racks;
  - With the new resources, the computational capacity of Pleiades will increase from a peak of 1.78 petaflops (PF) to approximately 2.87 PF.
- The resources were selected through the NASA Advanced Supercomputing (NAS) Division's formal NAS Technology Refresh (NTR) process.
- After installation and extensive testing, the new racks are scheduled for release to the general user community in late summer or early fall 2013.

Mission Impact: NASA's supercomputing requirements are projected to continue growing exponentially over time, as the agency leverages technology to pursue its challenging missions. HECC must regularly and significantly upgrade and replace the supercomputing resources it provides to the agency.

NASA's flagship Pleiades supercomputer. The formal NAS Technology Refresh process has concluded with the selection of SGI's next-generation ICE X system that will be added to Pleiades.

POCs: Piyush Mehrotra, piyush.mehrotra@nasa.gov, (650) 604-5126, Bill Thigpen, william.w.thigpen@nasa.gov, (650) 604-1061, NASA Advanced Supercomputing Division

Facilities Team Coordinates Cooling Tower Pump Repairs at NAS Facility

- The HECC facilities team, in coordination with the NASA Ames maintenance contractor (IAP World Services), completed the removal, repair, and re-installation of two cooling tower pumps.
  - The pumps are a critical component of the NAS facility's chilled water plant;
  - Issues were discovered with the pumps through ongoing inspection of the aging infrastructure;
  - Rebuilding the pumps extends the life of this critical equipment.
- Electrical testing to establish baselines was done at the time of installation; careful monitoring ensures that the hardware remains operational following installation.
- The team provided engineering solutions to ensure that adequate cooling was maintained during repairs, and that the repairs were made in a timely manner.

Mission Impact: Regular, effective maintenance of cooling tower pumps helps ensure that critical infrastructure at the NASA Advanced Supercomputing facility remains operational, especially during warm summer months when power outages could affect users' access to supercomputing resources.

A newly repaired cooling tower pump is hoisted by crane at the NASA Advanced Supercomputing (NAS) facility, to be re-installed into the chilled water plant located behind the NAS building. Two of four pumps were repaired and then re-installed.

POC: Scott Prevost, scott.prevost@nasa.gov, (650) 604-4350, NASA Advanced Supercomputing Division, Computer Sciences Corp.

HECC Increases Storage Capacity for NASA Earth Exchange (NEX) Researchers

- The HECC Supercomputing Systems team installed a Network File System (NFS) server to increase the storage capacity available for the NASA Earth Exchange (NEX) project.
- The NFS server provides 350 terabytes (TB) of usable storage space on Pleiades to NEX project researchers, augmenting an existing 424-TB Lustre filesystem.
- The new storage system uses the industry-standard T10-PI protocol for end-to-end data integrity validation, which will provide protection from silent (undetected) data corruption.
- The HECC team will next enable access the NFS server from the NEX sandbox using 10-Gigabit Ethernet. This will reduce duplication of data and enable NEX users to make more effective use of the storage system.

Mission Impact: Increased storage capacity and performance will enable researchers in the NASA Earth Exchange (NEX) community to more fully utilize HECC computing resources.

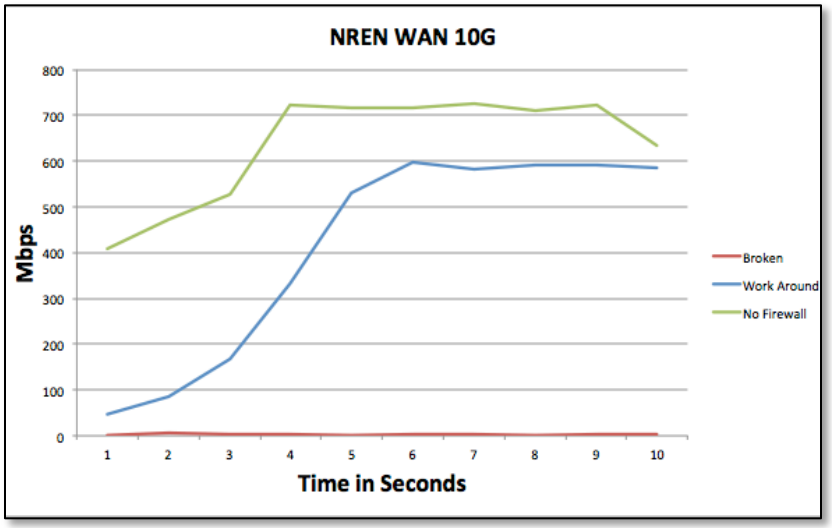
The new Network File System server will support two key components of the NASA Earth Exchange (NEX) workspace architecture—a sandbox with tools for building software codes and testing ideas, and the HECC supercomputers for running data analysis codes on a large scale.

POCs: Bob Ciotti, bob.ciotti@nasa.gov, (650) 604-4408, NASA Advanced Supercomputing Division;
Davin Chan, davin.s.chan@nasa.gov, (650) 604-3613, NASA Advanced Supercomputing Division, Computer Sciences Corp.

HECC Network Team Identifies Major Firewall Issue at MSFC

- In mid-March, the NASA Integrated Communication Services (NICS) support team upgraded NASA Ames' peering to the wide area network (WAN) backbone from 1 gigabit per second (Gbps) to 10 Gbps. Immediately, data transfer rates to Marshall Space Flight Center (MSFC) dropped dramatically.
- MSFC system administrators created accounts to allow HECC network engineers to isolate the problem.
- Working directly with NICS and MSFC engineers, the HECC engineers were able to bypass the MSFC firewall and quickly identify the problem—demonstrating that the MSFC firewall is not able to handle 10-Gbps data packet bursts.
- Until MSFC can upgrade their firewall, HECC has implemented a workaround to restore previous performance levels of ~575 Mbps.

Mission Impact: HECC's expertise and experience in high-speed networking, along with its collaborative approach, enables quick identification of, and solutions to, network performance issues.



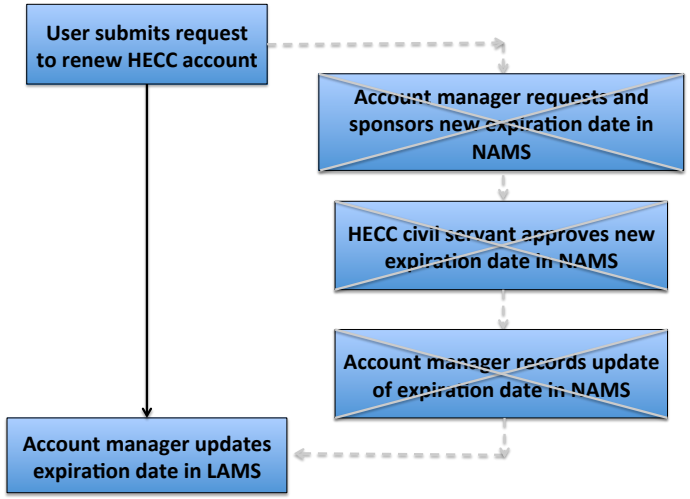
Network tests show the performance hit caused by 10 Gbps-sourced flows through the Marshall Space Flight Center Juniper firewall. As the graph above indicates, flows without the MSFC firewall in the path resulted in a dramatic improvement in performance. A work-around has been set up to use an alternate 1G path to NISN until the MSFC firewall can be upgraded.

POC: Nichole Boscia, nichole.k.boscia@nasa.gov, (650) 604-0891,
NASA Advanced Supercomputing Division,
Computer Sciences Corp.

Streamlined Account Request Process Saves Time for HECC Account Managers

- After reviewing the user account request process created when HECC began using the NASA Account Management System (NAMS), HECC account mangers streamlined the process by removing the expiration date that was in the NAMS workflow.
- Improving the workflow of the user account request process saves HECC account managers at least 100 hours per year.
- HECC users will continue to renew their accounts annually using HECC's online process.
- Account managers will update expiration dates for renewed accounts using HECC's Login Account Maintenance System (LAMS).
- The improved process also reduces confusion for users because they will no longer get renewal reminders from NAMS—the reminders will come only from HECC.

Mission Impact: Streamlining administrative processes enables HECC account managers to focus their expertise on helping users achieve their project goals instead of on routine tasks.



This diagram shows the three steps (at right) that were eliminated to streamline the HECC account renewal process. Account managers no longer update the NASA Account Management System (NAMS) when an account is renewed, nor do they synchronize expiration dates between NAMS and HECC's Login Account Maintenance System (LAMS). Account managers only update NAMS when an account is created or closed, so NAMS will still hold a record of users who have HECC accounts.

POC: Catherine Schulbach, catherine.h.schulbach@nasa.gov, (650) 604-3180, NASA Advanced Supercomputing Division

Security Team Completes Contingency Scenario Testing

- Under the direction of the NAS Security team, HECC successfully completed its annual testing of the contingency plan against a NASA Ames-provided training scenario that reflected significant agency-wide, temporary staff reductions.
  - HECC is required to perform a Functional Review or a Desktop/Classroom test each year;
  - A discussion-based Classroom exercise was chosen, since one such test is allowed within each three-year cycle and is less labor-intensive than the Functional Review.
- Representatives from all HECC groups took part in scenario-based discussions.
- Results of this year's exercise showed that HECC systems would have remained operational throughout the scenario, due to cross-trained NAS personnel and sufficient spare parts on hand (acquired to avoid placing emergency orders by a procurement office with limited staff).

Mission Impact: Annual contingency scenario testing helps identify and update areas of the HECC contingency plan that need modification. Testing is required to maintain authorization to operate the HECC systems.

The Contingency Plan cycle: Staff training ensures familiarity with the plan, then staff members try out the plan with HECC systems to respond to the testing scenario, followed by applying the lessons learned to plan updates.

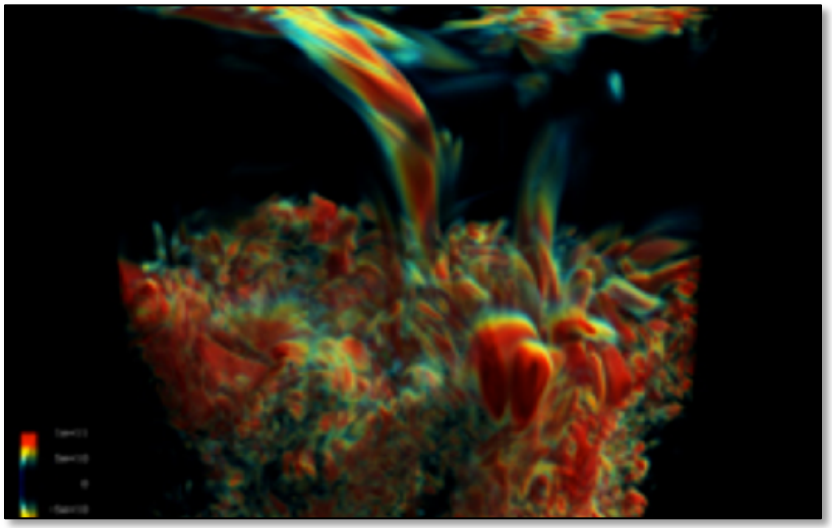
POC: Alfredo Ortiz, alfredo.a.ortiz@nasa.gov, (650) 604-0294, NASA Advanced Supercomputing Division, Computer Sciences Corp.

Magnetohydrodynamics Simulations Reveal Geyser-Like Plasma Eruptions on the Sun

- Researchers at NASA Ames and Stanford University, enabled by Pleiades' massive computational resources, are running 3D, radiative magnetohydrodynamics (MHD) simulations to reproduce ubiquitous plasma eruptions on the Sun. The simulations have revealed:
  - The plasma eruptions are produced by turbulent magnetized vortex tubes generated by solar convection below the visible surface;
  - These vortex tubes, with high-speed swirling flows similar to tornados, are initiated by overturning and shearing convective flows, driven by the solar energy flux;
  - Excess pressure that accumulates in the low atmosphere causes magnetized vortex tubes to erupt in a manner similar to geyser eruptions.
- These findings, enabled by HECC experts in 3D visualization, contribute to our understanding of solar magnetic activity and its affect on Earth's space environment.

** HECC provided supercomputing resources and services in support of this work*

Mission Impact: Knowledge gained from simulations of solar activity, enabled by HECC resources, are used to help interpret data from NASA's solar missions such as the Solar Dynamics Observatory (SDO), Hinode, and the Interface Region Imaging Spectrograph (IRIS); as well as for developing physics-based models of solar dynamics and activity.



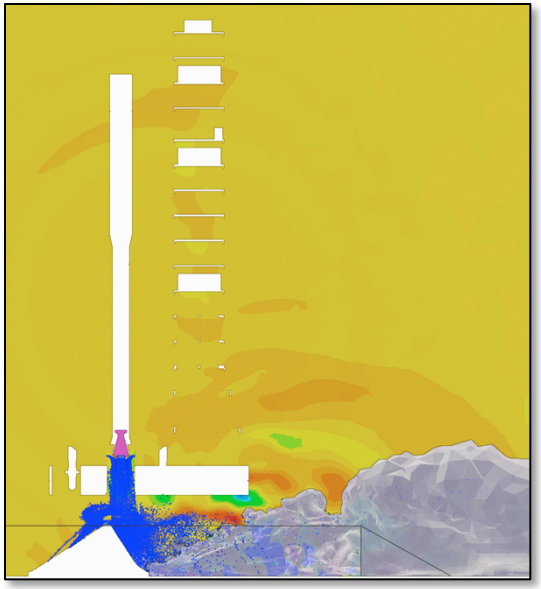
Visualization of kinetic helicity showing geyser-like eruptions above the subsurface, turbulent, convective layer of the Sun. The height of eruptions in this image is about 1,000 kilometers. Tim Sandstrom, NASA/Ames

POCs: Irina Kitiashvili, irinasun@stanford.edu, (650) 723-9596, Stanford University; Alan Wray, alan.a.wray@nasa.gov, (650) 604-6066, NASA Ames Research Center

Pleiades Enables Water Spray Simulation Models for SLS Launch Environment

- Researchers at Marshall Space Flight Center have simulated the effects of water suppression for a unique, wet launch pad validation case for the Space Launch System (SLS).
  - The simulation was based on a test case from the Ares I Scale Model Acoustic Test so that pressure predictions from across a full launch pad could be validated against real data;
  - Ignition overpressure and payload acoustics are design considerations that are consistent risk drivers for new launch vehicles;
  - Validations provided confidence in the results of CFD simulations, and had immediate impacts on design of the SLS.
- CFD prediction of acoustic effects for a full launch pad is computationally intensive, and would be very difficult without the resources of a supercomputer with Pleiades' capability and capacity.

Mission Impact: A robust and validated computational fluid dynamics capability is critical to rocketry design, allowing NASA to quickly iterate through options that would be difficult to assess with traditional methods. Identifying and fixing design problems prior to fabrication provides significant cost savings to the agency.



Snapshot of ignition pressure contours through the centerline of a simulation as the overpressure propagates through the launch tower and an evaporation cloud of water forms in the flame trench. NAS Visualization Team/ NASA Ames

** HECC provided supercomputing resources and services in support of this work*

POC: Gabriel Putnam, gabriel.c.putnam@nasa.gov, (256) 544-9577, NASA Marshall Space Flight Center, All Points Logistic, Inc.

HECC Facility Hosts Several Visitors and Tours in June 2013

- HECC hosted 14 tour groups in June; guests learned about the agency-wide missions being supported by Pleiades/Endeavour, and viewed scientific results on the hyperwall system. Visitors this month included:
  - The Rector, Vice Rector, and Director of Research Institutes from the Kaunas University of Lithuania;
  - A group from the NASA Office of Inspector General, Computer Crime Division;
  - Javier Mendieta, Director General of the Mexican Space Agency;
  - Former NASA Deputy Director and Ames Center Director, Hans Mark, received a briefing by HECC Project Manager Rupak Biswas on the quantum computer project;
  - Liane Guild, Ames Coral Reef scientist, met with HECC visualization team lead Chris Henze and guests from NOAA and other ocean studies centers, to discuss future collaborations;
  - Two large student groups from the Summer Interns Program, Ames Office of Education.

HECC Deputy Project Manager Bill Thigpen shows the Pleiades supercomputer to a group of visitors including the Rector, Vice Rector, and Director of Research Institutes at Kaunas University of Lithuania, during a tour this month.

POC: Gina Morello, gina.f.morello@nasa.gov, (650) 604-4462, NASA Advanced Supercomputer Division

Papers and Presentations

- **AIAA Fluids Conferences,** June 24-27, 2013, San Diego, California
  - "Computational Prediction of Pressure and Thermal Environments in the Flame Trench," C. Brehm, E. Sozer, S. Moini-Yekta, J. Housman, C. Kiris, M. Barad, B. Vu, P. Christopher. *http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-2538* *
  - "1D and 2D Simulations Related to the NASA Electric Arc Shock Tube Experiments," D. V. Kotov, H. Yee, M. Panesi, D. Prabhu, A. Wray. *http://arc.aiaa.org/doi/pdf/10.2514/6.2013-2435* *
  - "Verification and Validation Studies for the LAVA CFD Solver," S. Moini-Yekta, M. Barad, J. Housman, C. Kiris, E. Sozer, C. Brehm. *http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-2448* *
  - "Predictions of Convective Heat Transfer Rates Using a Cartesian Grid Solver for Hypersonic Flows," S. Sekhar, S. Ruffin. *http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-2645* *
  - "Porous-Material Analysis Toolbox based on OpenFOAM-extended and Applications," J. Lachaud, N. Mansour. *http://arc.aiaa.org/doi/pdf/10.2514/6.2013-2767* *
  - "High Lift OVERFLOW Analysis of the DLR F11 Wind Tunnel Model," T. Pulliam, A. Sclafani. *No online version available at this time.* *
  - "A New Approach to Light-Weight Ablators Analysis: From Micro-Tomography Measurements to Statistical Analysis and Modeling," N. Mansour, et al. *http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-2768* *
  - "Flow-Tube Oxidation Experiments on the Carbon Preform of PICA," F. Panerai, A. Martin, N. Mansour, S. Sepka, J. Lachaud. *http://arc.aiaa.org/doi/pdf/10.2514/6.2013-2769* *
  - "Design of a Variational Multiscale Method for High Reynolds Number Compressible Flows," L. Diosady, S. Murman. *http://arc.aiaa.org/doi/pdf/10.2514/6.2013-2870* *

** HECC provided supercomputing resources and services in support of this work*

Papers and Presentations (cont.)

- **AIAA Fluids Conferences,** June 24-27, 2013, San Diego, California (cont.)
  - "An Efficient CFD-Based PID Control Free Shear Layer Flow," U. Kaul. *http://arc.aiaa.org/doi/pdf/10.2514/6.2013-2986* *
  - "Efficient Creation of Overset Grid Hole Boundaries and Effects of Their Locations on Aerodynamic Loads," W. Chan, S. Pandya, S. Rogers. *http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-3074* *
  - "Microscopic Simulation and Macroscopic Modeling for Thermal and Chemical Non-Equilibrium Gases," Y. Liu, M. Panesi, M. Vinokur, P. Clarke. *http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-3146* *
  - "Performance of Reynolds Averaged Navier-Stokes Models in Predicting Separated Flows: Study of the Hump Flow Model Problem," D. Cappelli, N. Mansour. *No online version available at this time.* *
  - "Comparison of Computed and Measured Vortex Evolution for a UH-60A Rotor in Forward Flight," J. Ahmad, G. Yamauchi, D. L. Kao. *http://arc.aiaa.org/doi/pdf/10.2514/6.2013-3160*
  - "Multi-Group Reductions of LTE Air Plasma Radiative Transfer in Cylindrical Geometries," J. Scoggins, T. Magin, A. Wray, N. Mansour. *http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-3142* *
  - "Validation of HyperRad for Earth Entries," A. Brandis, A. Wray, Y. Liu, D. Schwenke, W. Huo, C. Johnston. *http://arc.aiaa.org/doi/pdf/10.2514/6.2013-2777* *
  - "Separation Prediction of Large Separation with Reynolds Stress Models," M. Olsen, R. Lillard, S. Murman, M. Rivers, K. Long, J. Ross. *

** HECC provided supercomputing resources and services in support of this work*

Papers and Presentations (cont.)

- "**Kinetic Simulation of Plasmoid Chain Dynamics**," S. Markidis, et al., arXiv:1306.1050 [physics.plasm-PH], June 2, 2013. *
  http://arxiv.org/abs/1306.1050
- "**Location of the Bow Shock Ahead of Cloud G2 at the Galactic Centre**," A. Sadowski, et al., Monthly Notices of the Royal Astronomical Society, June 17, 2013. *
  http://mnras.oxfordjournals.org/content/early/2013/06/17/mnras.stt879.full
- "**The Same Frequency of Planets Inside and Outside Open Clusters of Stars**," S. Meibom, et al., Nature, June 26, 2013. *
  http://www.nature.com/nature/journal/vaop/ncurrent/full/nature12279.html
- "**Coupled Flow Field Simulations of Charring Ablators with Nonequilibrium Surface Chemistry**," H. Alkandry, I. Boyd, A. Martin, 44th AIAA Thermodynamics Conference, San Diego, CA, June 24-27, 2013. *
  http://arc.aiaa.org/doi/pdf/10.2514/6.2013-2634
- "**Consistent Modeling of Rotational Nonequilibrium in a Hybrid Particle-Continuum Method**," A. Verdoff, I. Boyd, 44th AIAA Thermodynamics Conference, San Diego, CA, June 24-27, 2013. *
  http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-3145

** HECC provided supercomputing resources and services in support of this work*

Papers and Presentations (cont.)

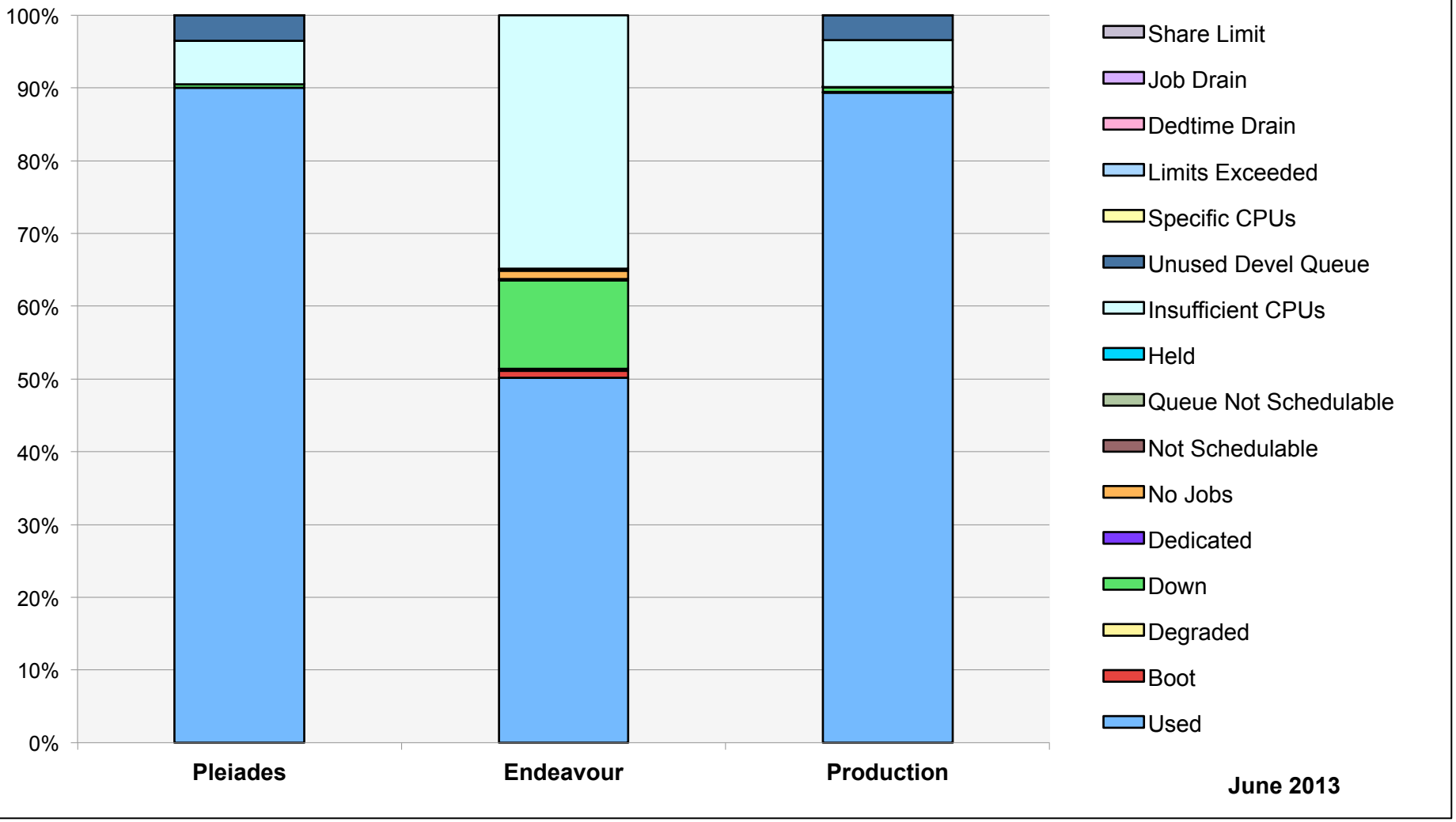
- "**Direct Numerical Simulation of Transition in a Swept-Wing Boundary Layer**," L. Duan, M. Choudhari, F. Li, 43rd AIAA Fluid Dynamics Conference, San Diego, CA, June 24-27, 2013. *
  http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-2617
- "**Investigation of Subgrid Closure Models for Finite-Rate Scramjet Combustion**," A. Potturi, J. Edwards, 43rd AIAA Fluid Dynamics Conference, San Diego, CA, June 24-27, 2013. *
  http://arc.aiaa.org/doi/pdfplus/10.2514/6.2013-2461

** HECC provided supercomputing resources and services in support of this work*

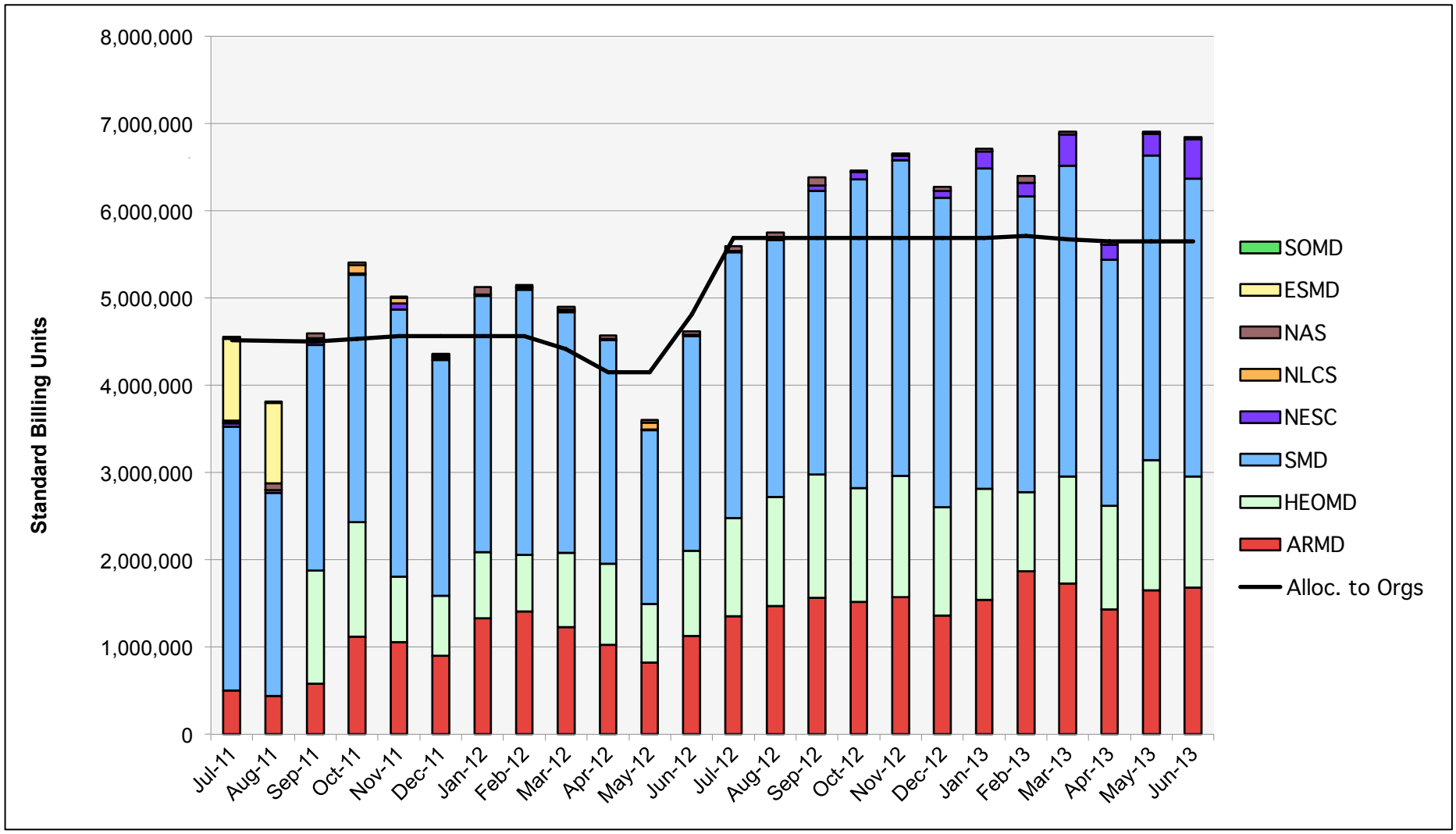
News and Events

- **NASA Launches Satellite to Study How Sun's Atmosphere is Energized,** *NASA Press Release,* June 27, 2013 – The Interface Region Imaging Spectrograph (IRIS) begins its two-year mission to observe the region between the Sun's photosphere and lower atmosphere, which will include data processing and analysis on the Pleiades supercomputer.
  http://www.nasa.gov/centers/ames/news/2013/13-48AR-nasa-launches-sat-to-study-solar-atmosphere.html
  - **NASA Launches IRIS Solar Mission to Research Space Weather,** *TechHive,* June 28, 2013. *http://www.techhive.com/article/2043216/nasa-launches-iris-solar-mission-to-research-space-weather.html*
  - **NASA Launches Satellite to Study How Sun's Atmosphere is Energized,** *Space Fellowship,* June 28, 2013. *http://spacefellowship.com/news/art34328/nasa-launches-satellite-to-study-how-sun-s-atmosphere-is-energized.html*

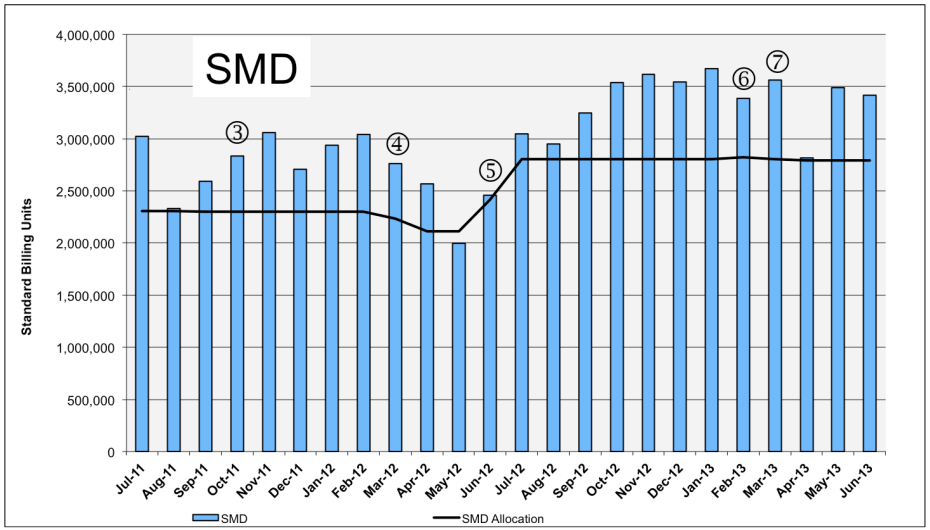
HECC Utilization

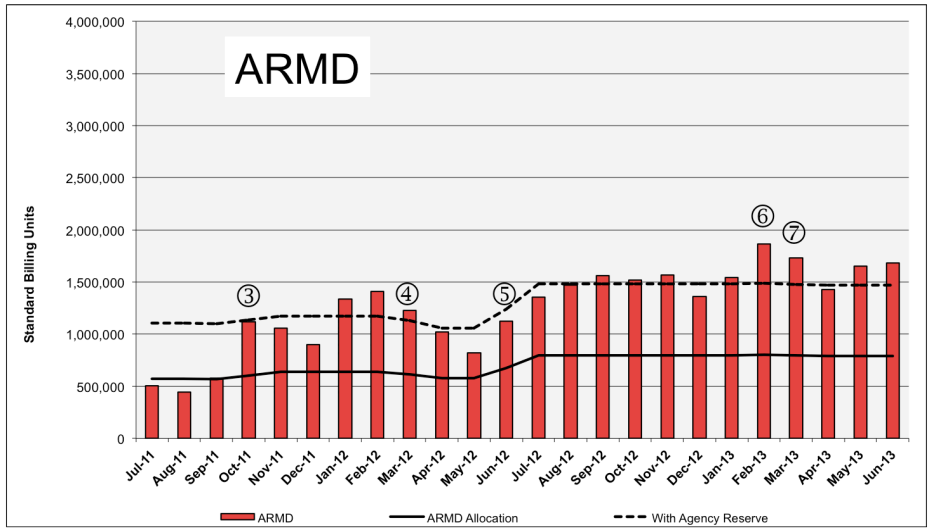


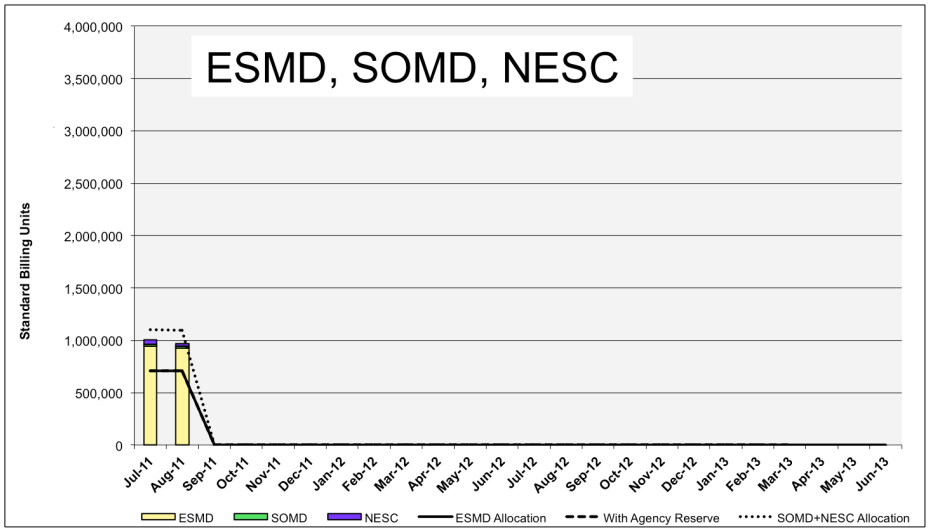
HECC Utilization Normalized to 30-Day Month

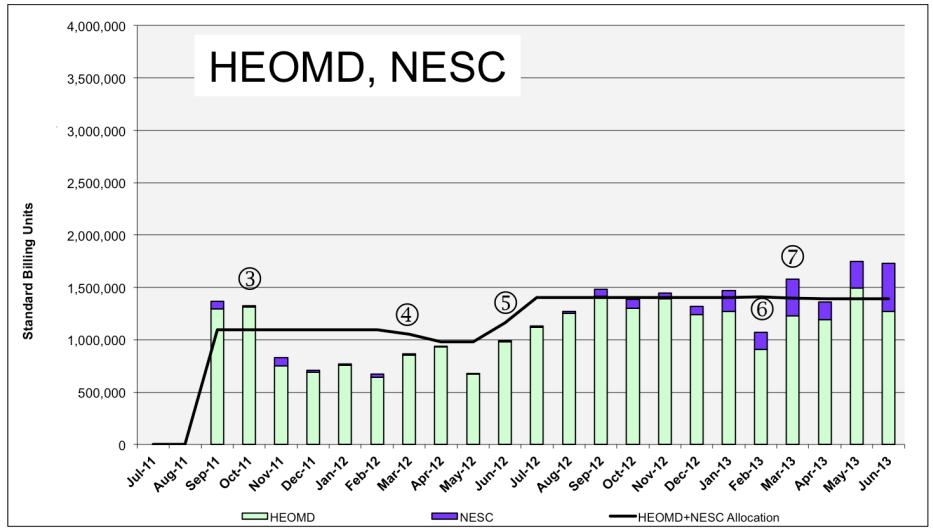


HECC Utilization Normalized to 30-Day Month



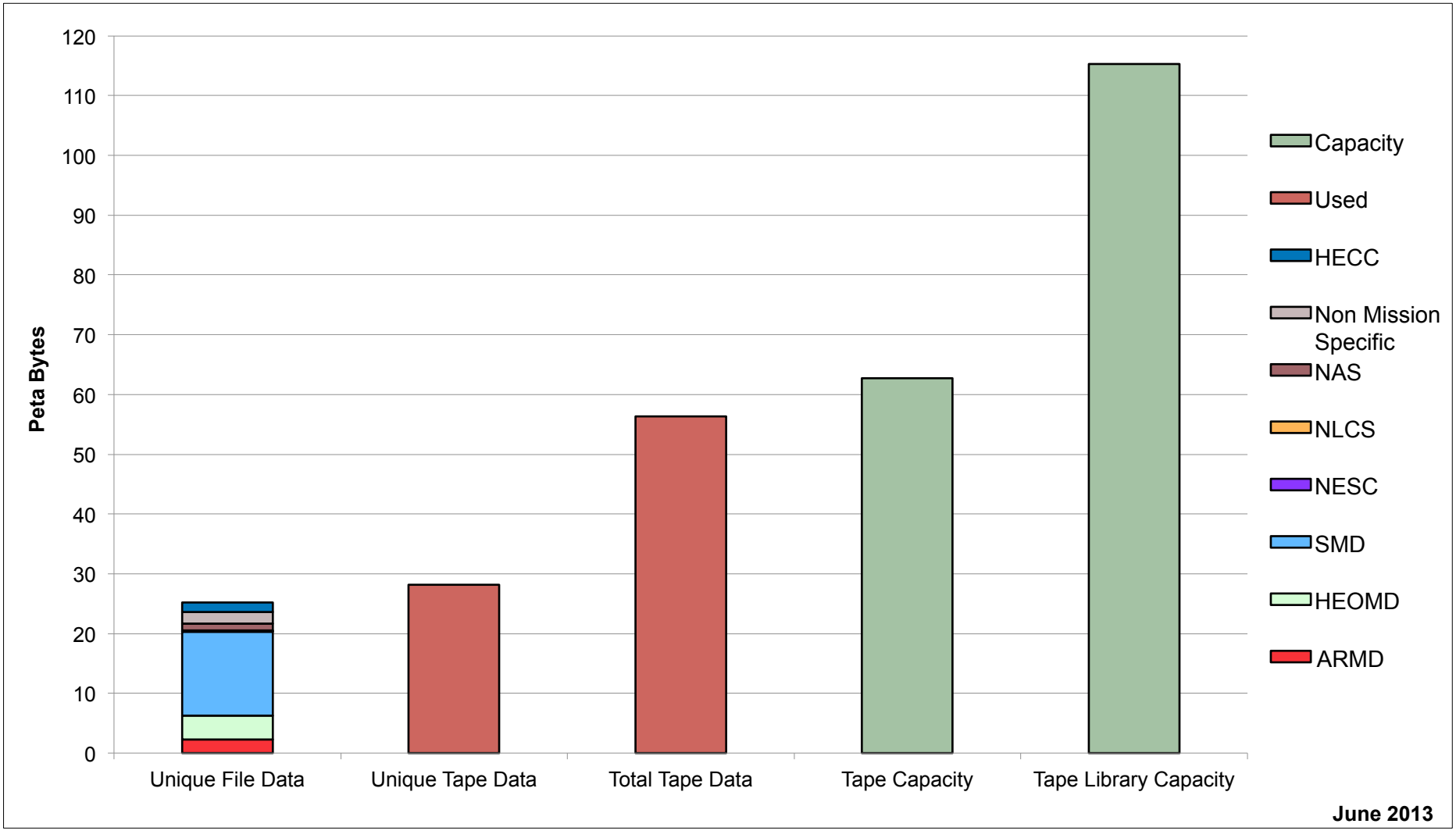






② 14 Westmere racks added ③ 2 ARMD Westmere racks added ④ 28 Harpertown racks removed ⑤ 24 Sandy Bridge racks added
⑥ Columbia 21, 23, and 24 removed; Endeavour 2 added ⑦ Columbia 22 removed, Endeavour 1 added

Tape Archive Status



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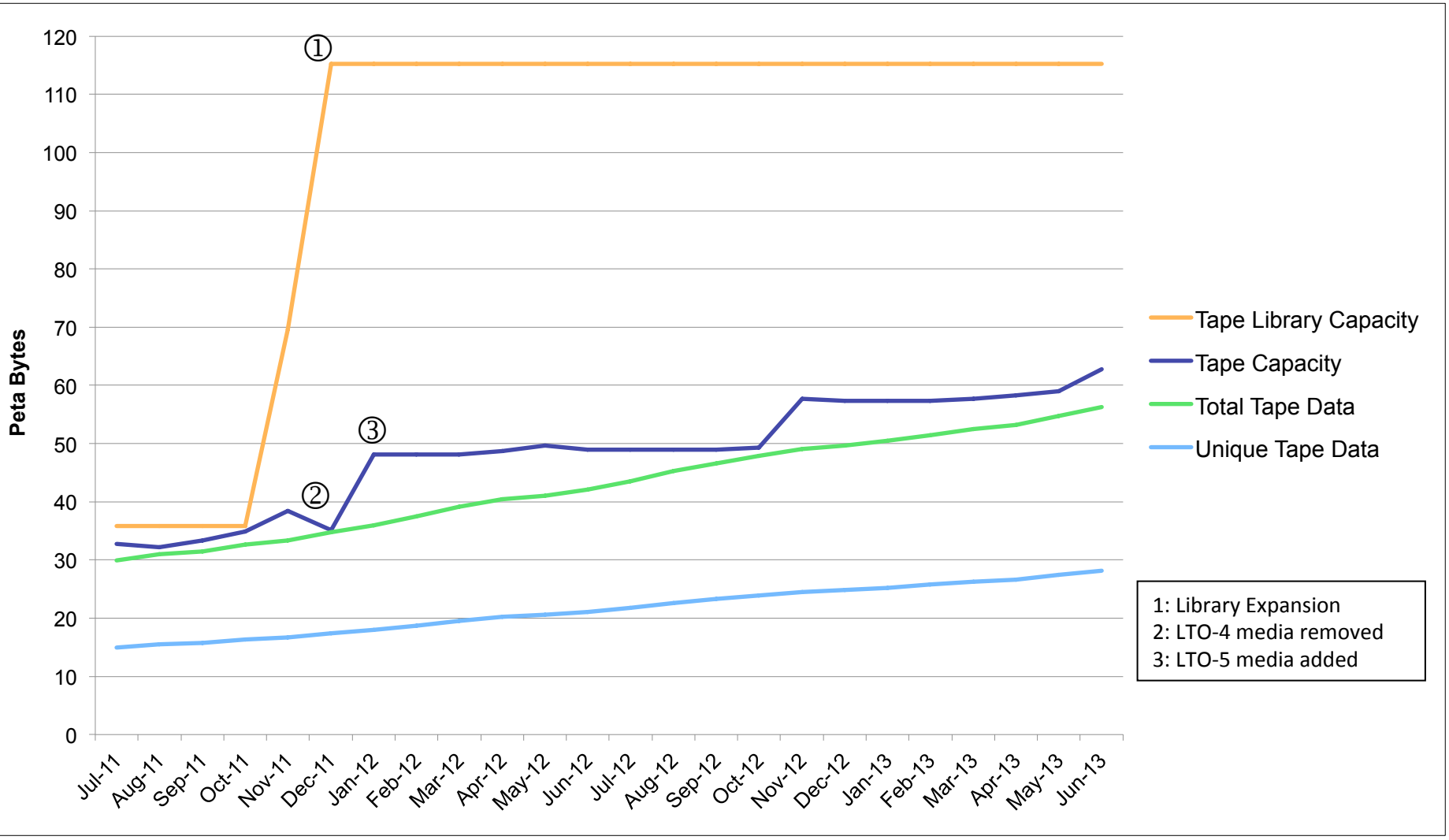
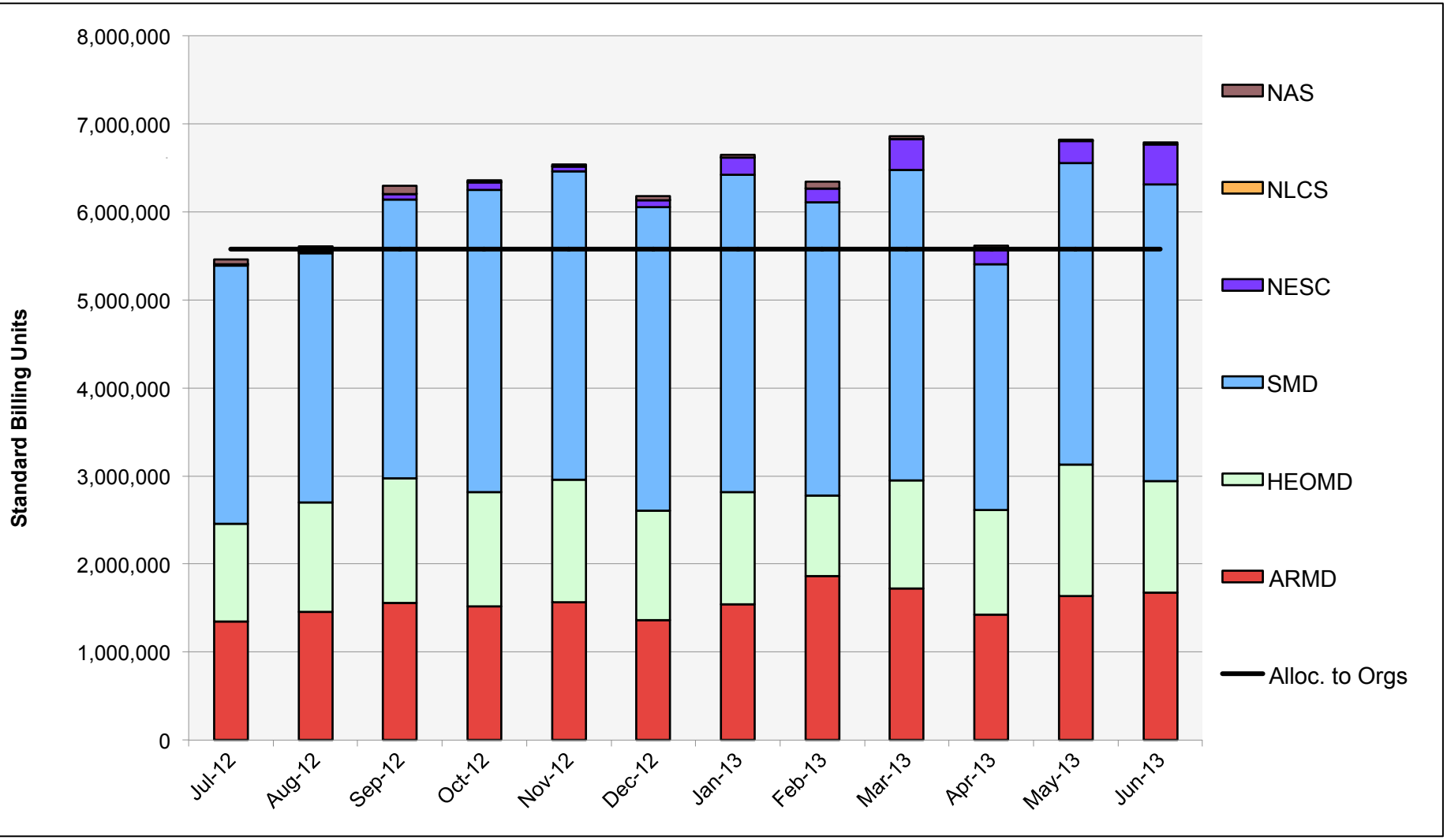
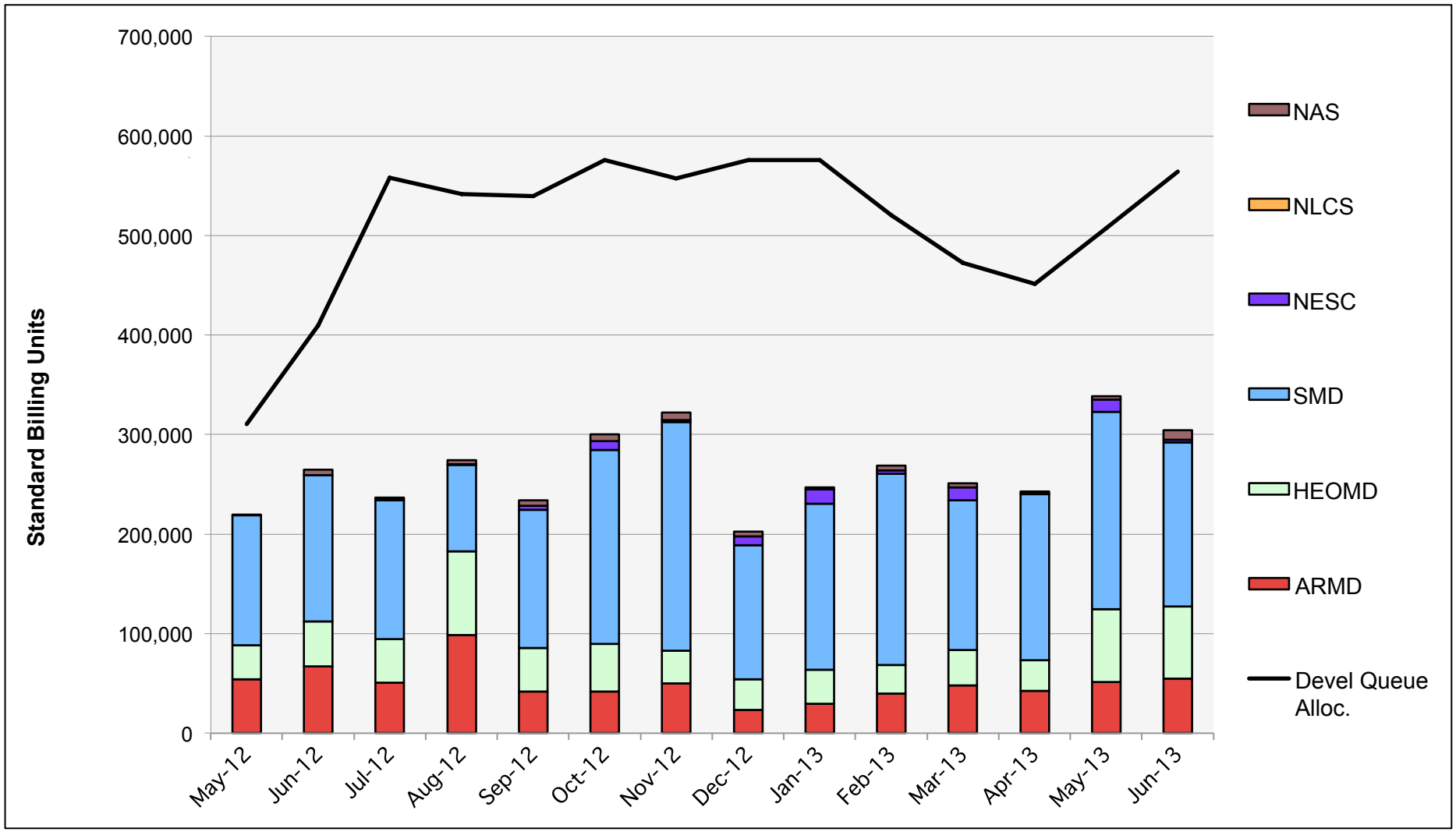


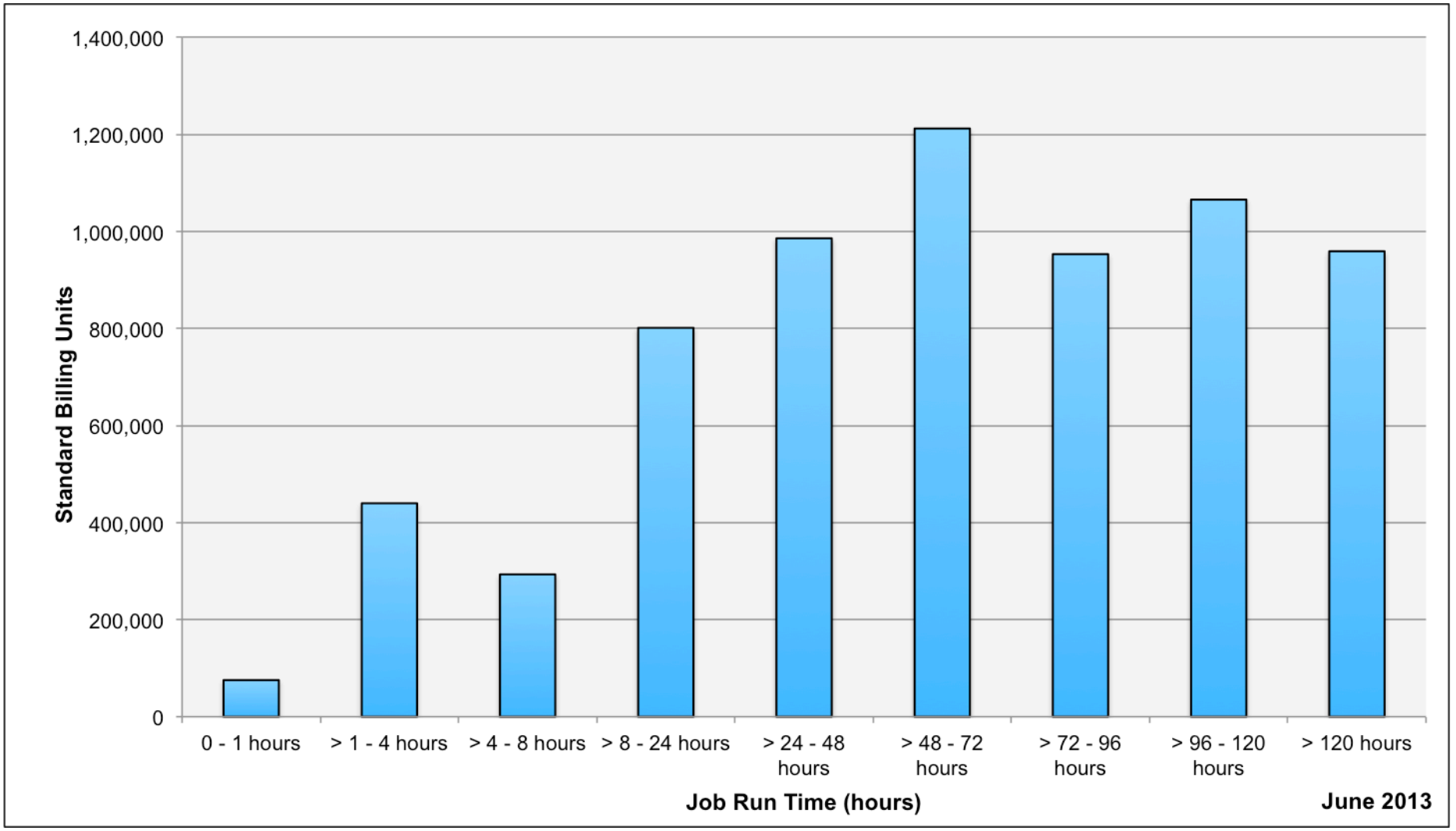
Pleiades:
SBUs Reported, Normalized to 30-Day Month



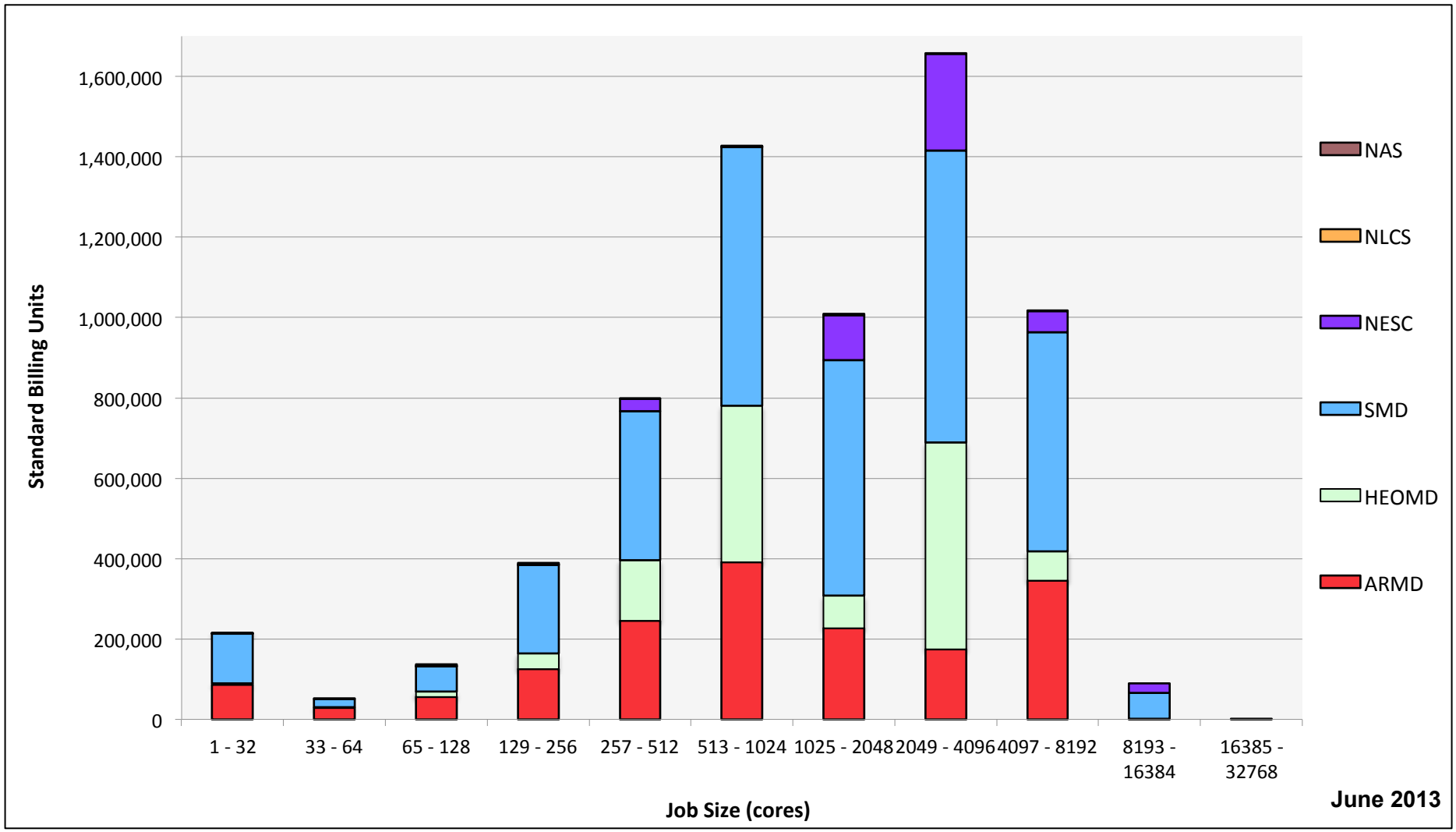
Pleiades:
Devel Queue Utilization



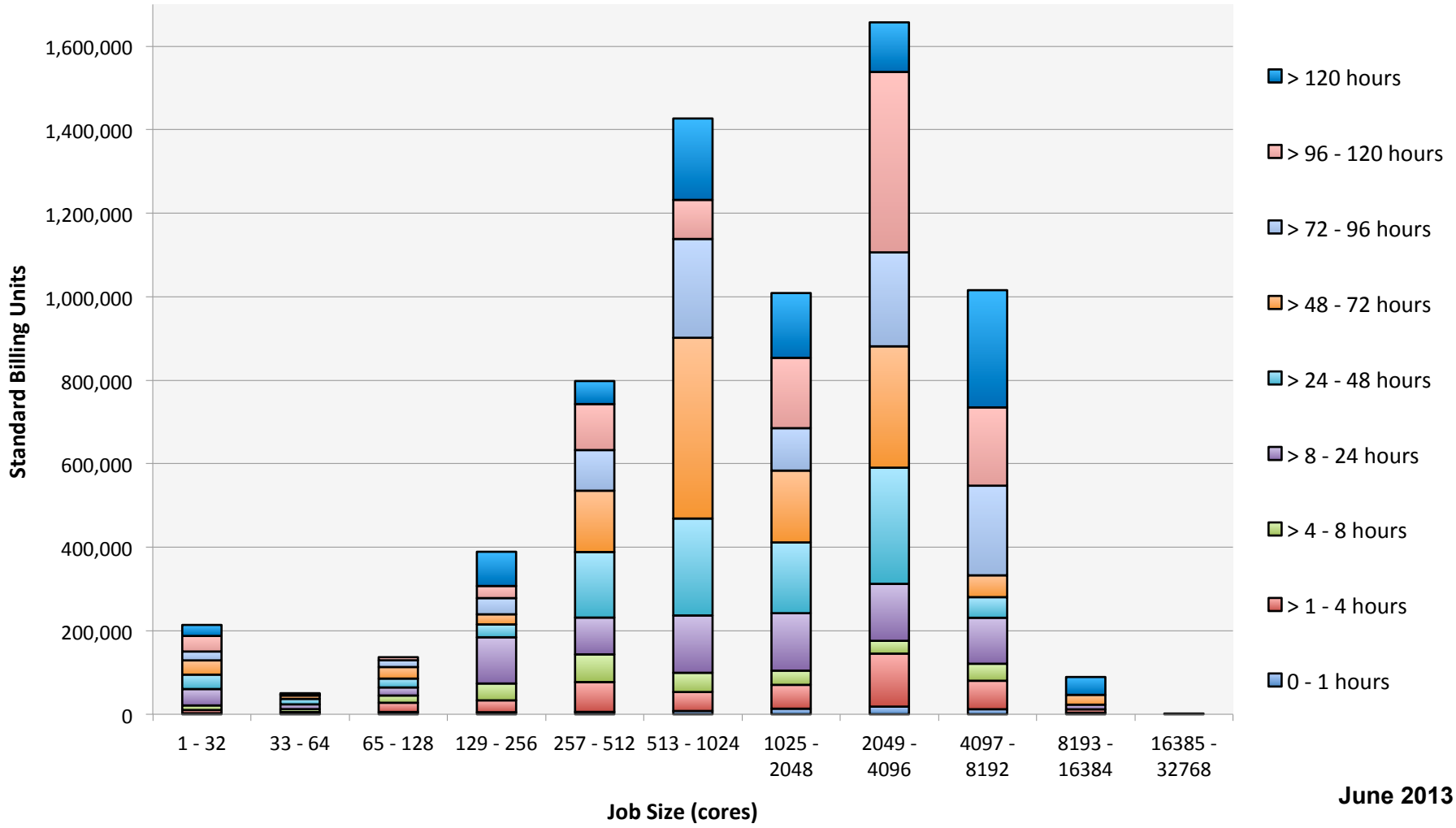
Pleiades:
Monthly Utilization by Job Length



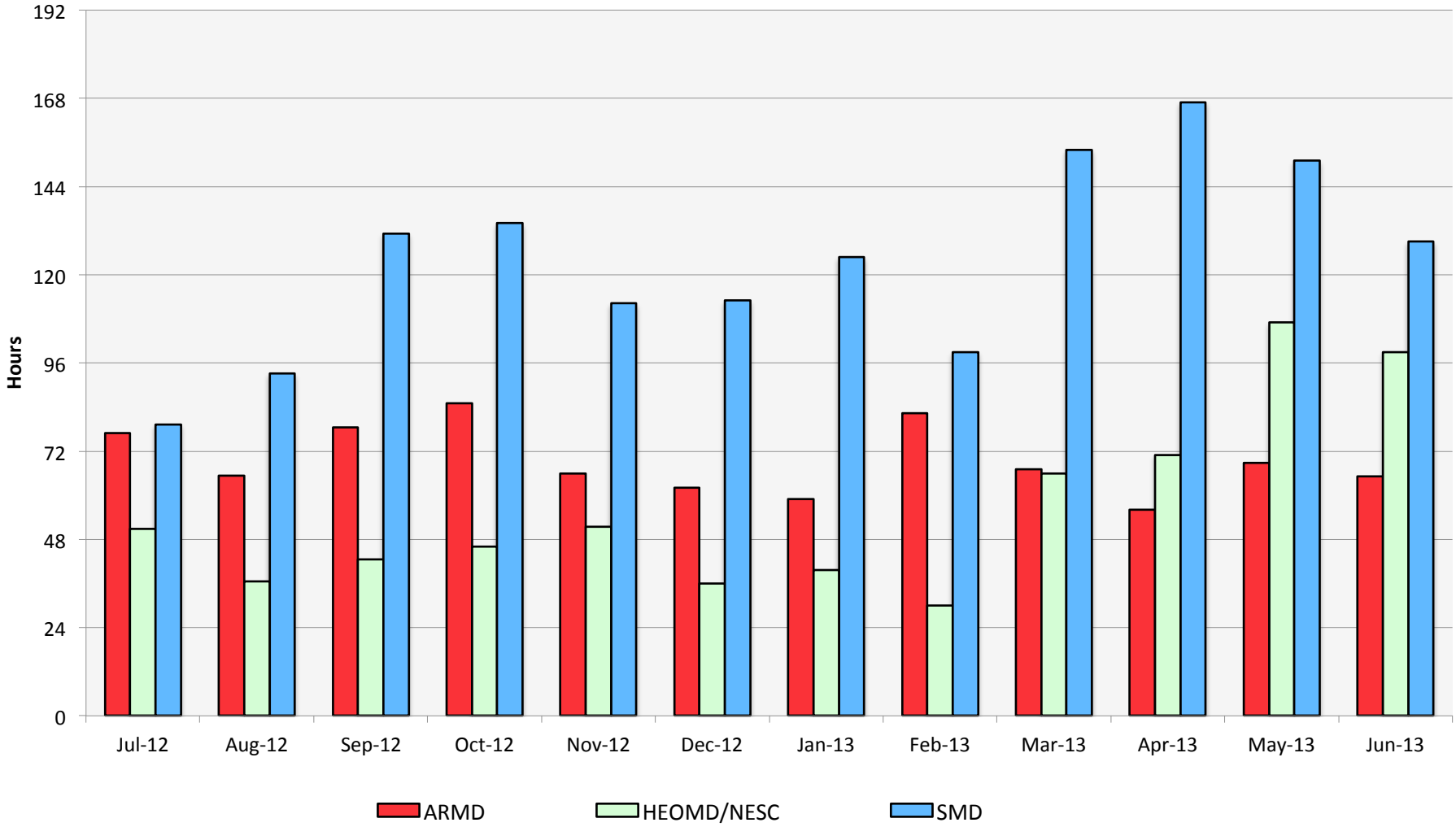
Pleiades:
Monthly Utilization by Size and Mission



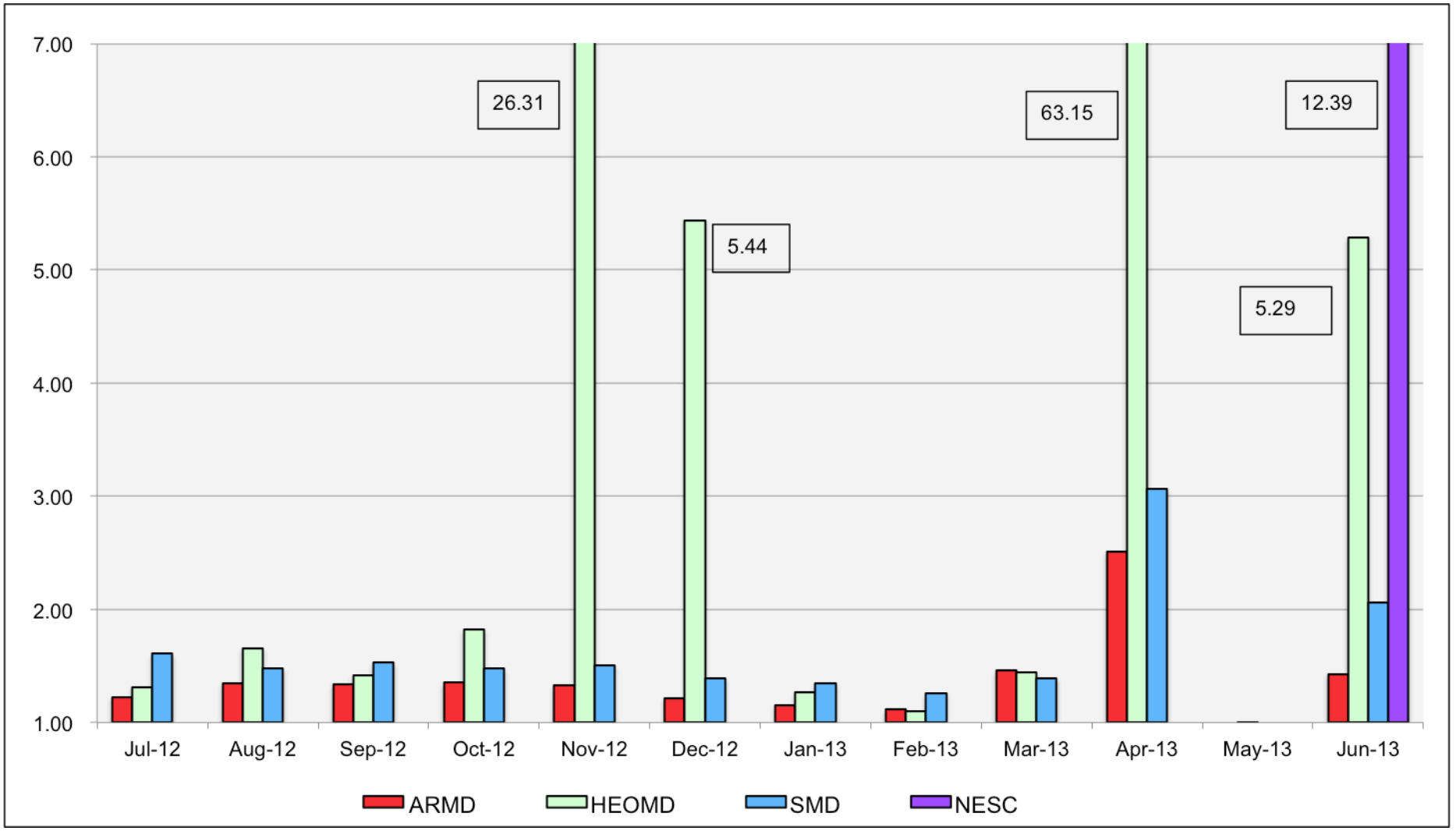
Pleiades:
Monthly Utilization by Size and Length



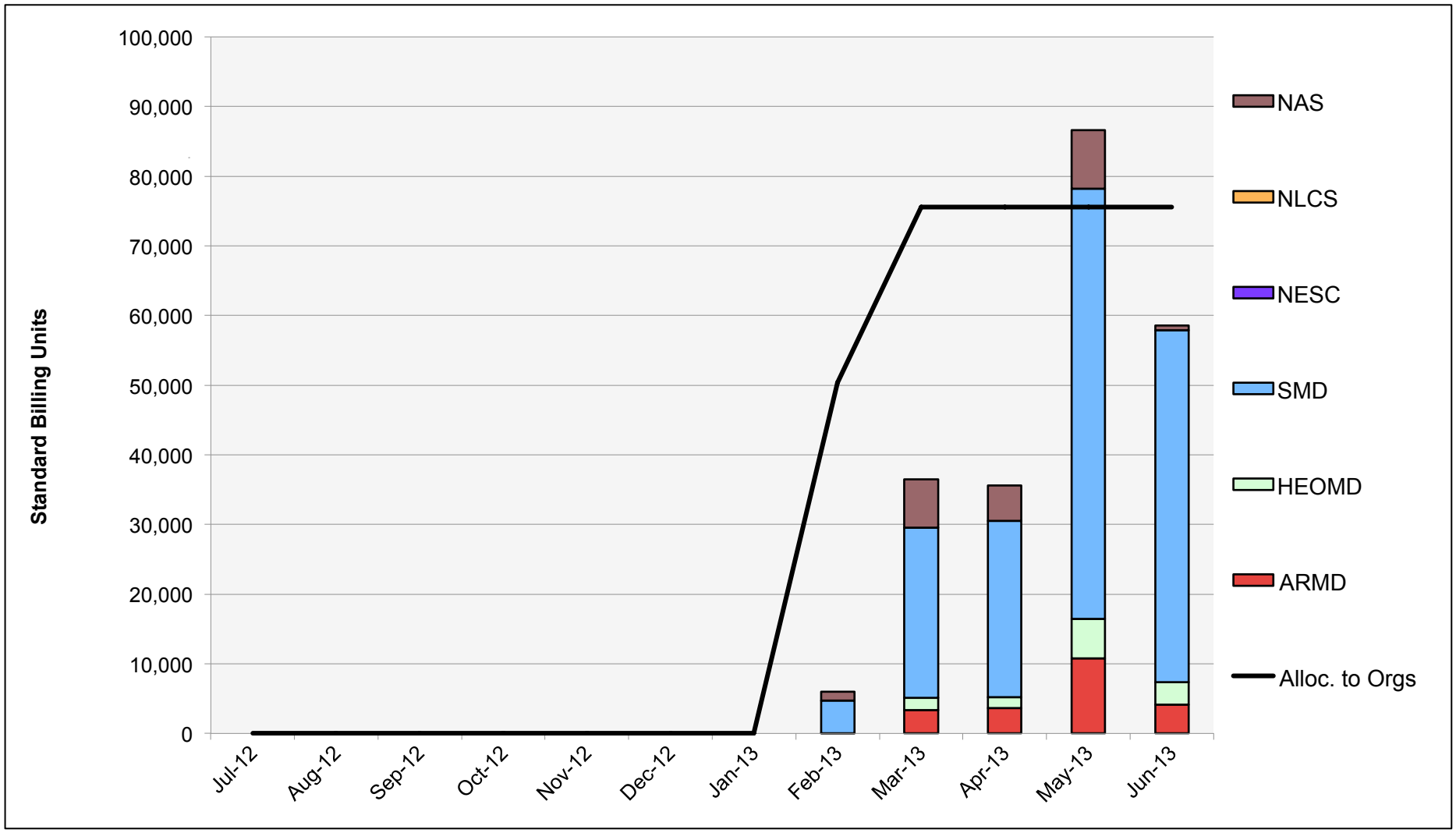
Pleiades:
Average Time to Clear All Jobs



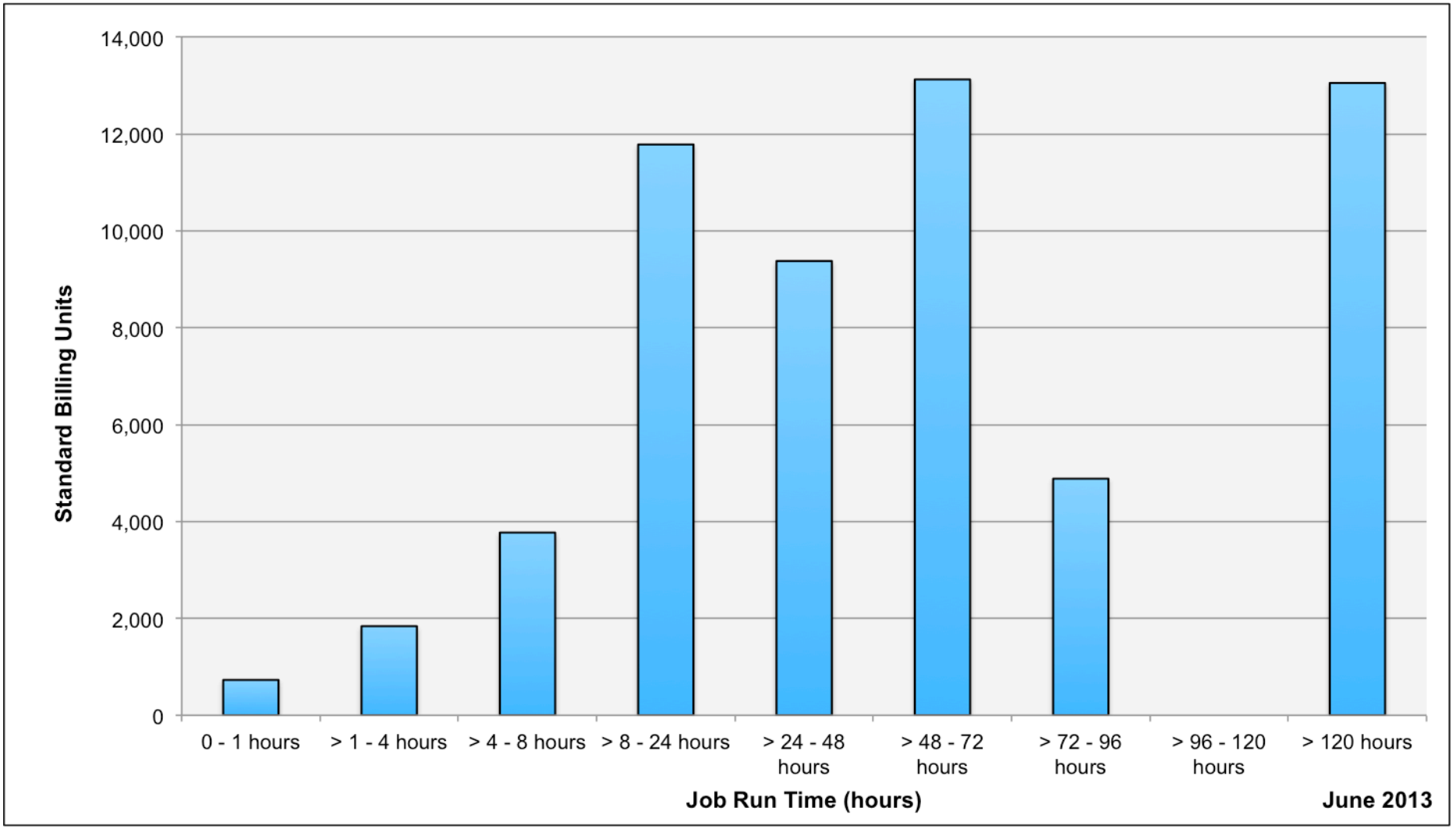
Pleiades:
Average Expansion Factor



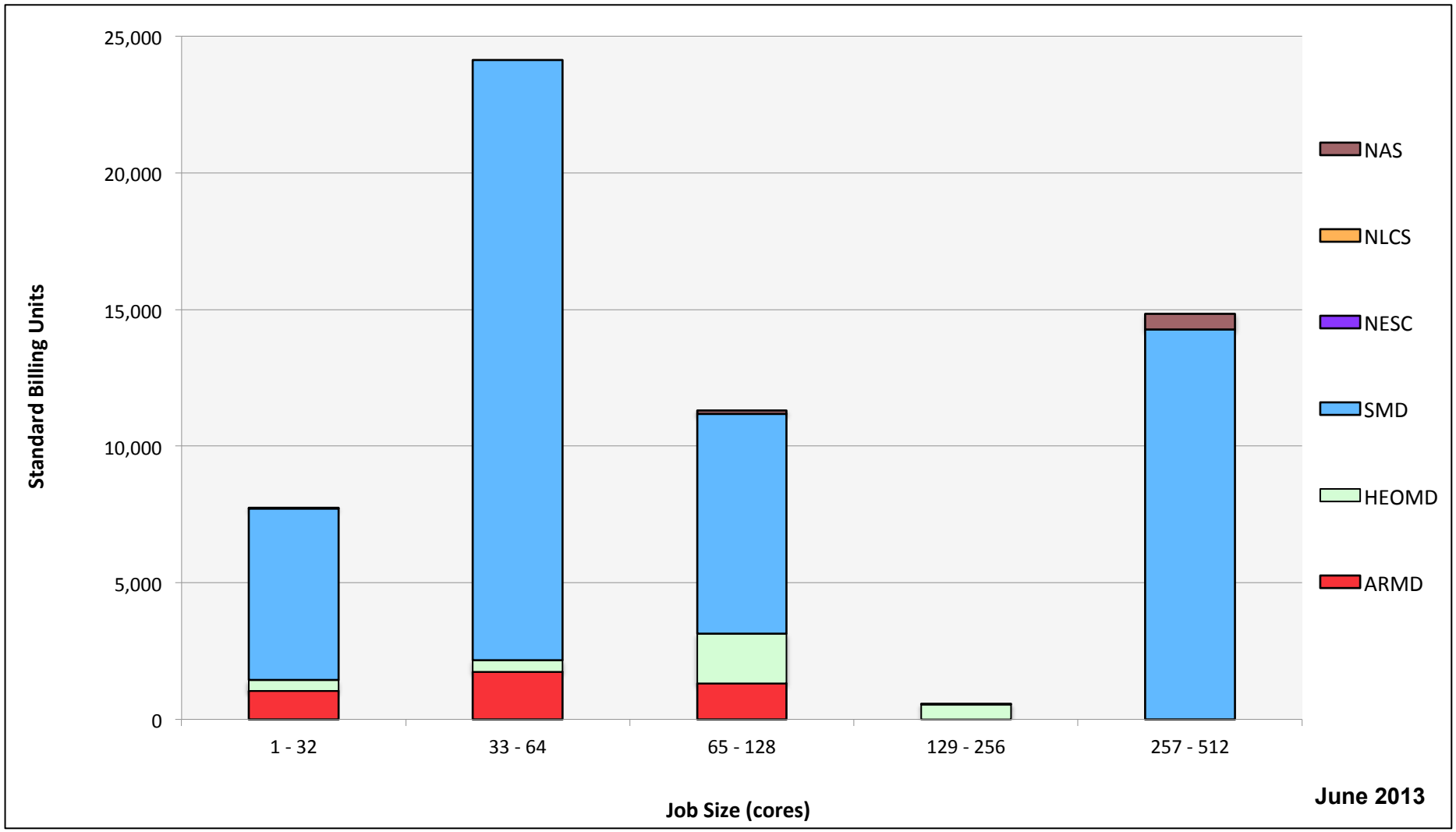
Endeavour:
SBUs Reported, Normalized to 30-Day Month



Endeavour:
Monthly Utilization by Job Length



Endeavour:
Monthly Utilization by Size and Length



Endeavour:
Monthly Utilization by Size and Mission