



# Project Status Report

## High End Computing Capability Strategic Capabilities Assets Program

July 10, 2016

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# Remaining Westmere Nodes Retired from Pleiades



- HECC systems engineers retired the last of the Pleiades Westmere nodes on June 20 in preparation for the deployment of 14 new Broadwell racks that arrived on June 24.
- Retiring the Westmere nodes provides the power and cooling necessary for the deployment of the Broadwell racks. When the new racks are deployed, Pleiades will have a peak performance of 7.25 petaflops.
- 12 Westmere racks and 2 Westmere/graphics processing unit racks were removed during a suspend/resume process for Pleiades jobs, which avoided draining of all of the compute nodes on the system and minimized the impact on users.
- Three-and-a-half Broadwell racks provide the equivalent processing power of the retired Westmere racks.

**Mission Impact:** To meet NASA's rapidly increasing requirements for high-performance computing, HECC must regularly and significantly upgrade and replace the supercomputing resources provided to the agency.



Three-and-a-half Broadwell racks on the Pleiades supercomputer will provide the equivalent number of Standard Billing Units of 14 Westmere racks. The new Broadwell racks were available to users July 1.

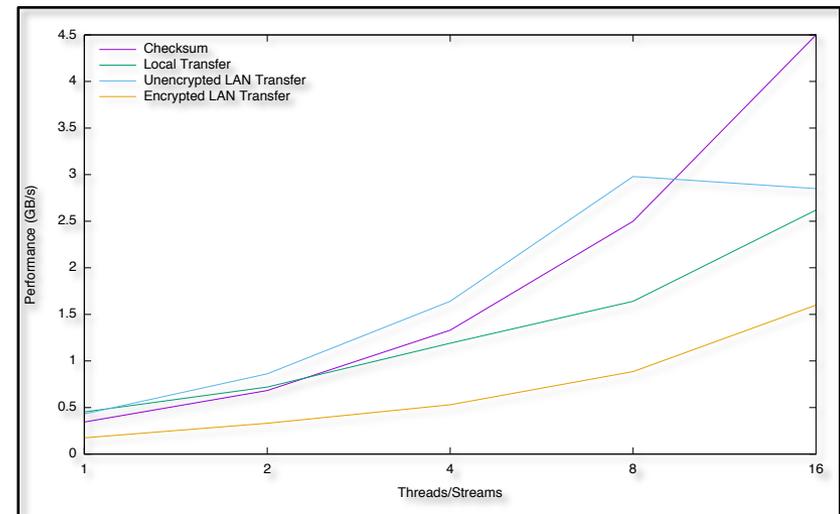
**POCs:** Bob Ciotti, [bob.ciotti@nasa.gov](mailto:bob.ciotti@nasa.gov), (650) 604-4408, NASA Advanced Supercomputing (NAS) Division;  
Davin Chan, [davin.chan@nasa.gov](mailto:davin.chan@nasa.gov), (650) 604-3613, NAS Division, CSRA LLC

# Shift Transfer Tool Enhanced with Multi-Threading and New Remote Transport



- HECC's in-house automated data transfer tool, Shift, utilizes both high performance external tools and equivalent built-in functionality to transfer data and verify data integrity after transfer.
- Previously, built-in functionality had only a single thread of execution and was only able to transfer files remotely over SSH streams.
  - Built-ins could not achieve highest performance because they could not fully utilize resources.
  - External tools achieved higher performance but remote users had to build and install them.
- HECC Systems staff augmented Shift built-ins to utilize multiple threads of execution and added a new remote transport that operates directly over Transmission Control Protocol (TCP) streams.
- Remote users can now achieve higher performance without external tools:
  - Checksums: up to 13x speedup
  - Local copies: up to 6x speedup
  - Remote unencrypted copies: up to 7x speedup
  - Remote encrypted copies: up to 9x speedup

**Mission Impact:** By augmenting the functionality of the Shift transfer tool, remote HECC users can significantly reduce transfer time of their large datasets without having to install other external tools.



Checksums and transfers of 64 1-gigabyte files using pure Perl built-in functionality within Shift. Multi-threading significantly improves performance of checksums, local transfers, and encrypted remote transfers (measured over the local area network). A new unencrypted remote transport provides significant improvements over encrypted transports without the need for external tools with similar functionality, such as bbftp.

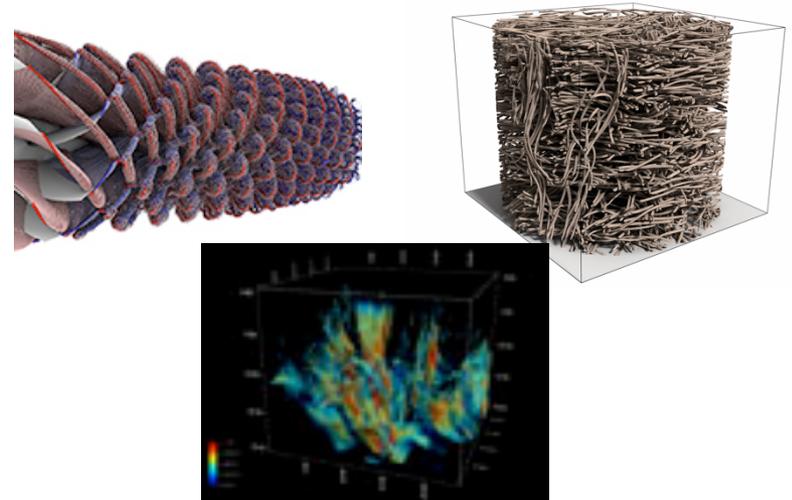
**POCs:** Bob Ciotti, bob.ciotti@nasa.gov, (650) 604-4408, NASA Advanced Supercomputing (NAS) Division;  
Davin Chan, davin.chan@nasa.gov, (650) 604-3613, NAS Division, CSRA LLC

# June 2016 Computer Usage on Pleiades Sets Monthly Record of 17.73 Million SBUs



- June 2016 usage on the Pleiades supercomputer set a new monthly record.
- 17.73 million Standard Billing Units (SBUs\*) were used by NASA's science and engineering organizations, exceeding the previous record of 17.0 million SBUs that was set in May 2015.
- This increase was enabled by the recent installation of 1008 new Broadwell nodes that increased Pleiades' resources by 17%.
- Over 300 projects from all across NASA used time on Pleiades during June.
- The top 10 projects used from 401,373 to 1,629,304 SBUs each and together accounted for over 41% of total June usage.
- The HECC Project continues to plan and evaluate ways to address the future requirements of NASA's users.

**Mission Impact:** Increasing Pleiades' system capacity provides Mission Directorates with more resources for the accomplishment of their goals and objectives.



Images representing projects on Pleiades from different Mission Directorates. From top left: (1) Visualization of a contra-rotating, open-rotor simulation—one concept being studied to create cleaner, quieter aircraft. *M. Barad, C. Kiris, NASA/Ames.* (2) Image of carbon fiber felt material being analyzed for stronger and safer materials to protect future spacecraft. *F. Panerai, N. Mansour, NASA/Ames.* (3) Simulation of the sun's emerging magnetic field to increase NASA's understanding of the sun. *R. Stein, Michigan State University.*

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

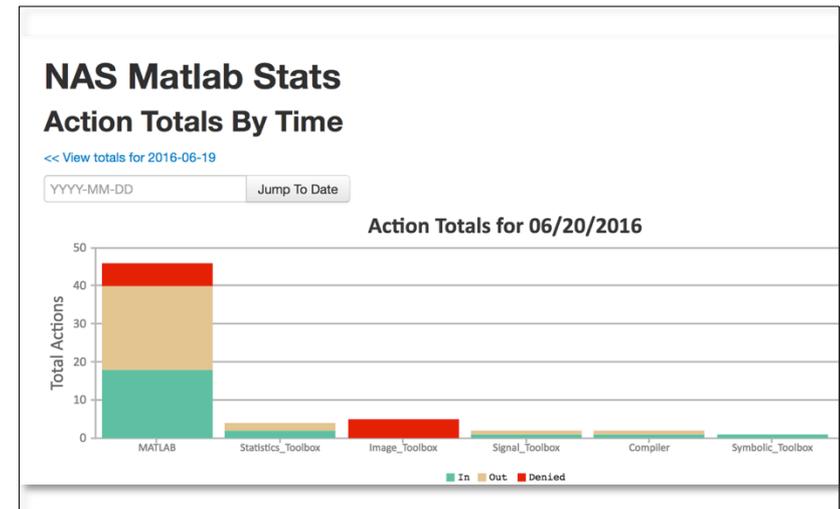
\* 1 SBU equals 1 hour of a Pleiades Westmere 12-core node

# Matlab Stats Website Helps HECC Team Monitor and Manage Matlab Licenses



- To improve the availability of the Matlab and Matlab toolbox licenses and maintain an appropriate number of licenses to meet user needs, the HECC Tools team developed the Matlab Stats website. The site allows HECC staff to monitor license check-ins, checkouts, and denials.
- Features of the website include:
  - Daily, detailed information on each product showing licenses checked in and out and the number of denials for the product.
  - Automated tickets for users getting over 50 denials of a license within an hour. HECC staff will work with identified users to inform them of better license usage methods to reduce the possibility of license denials.
  - Details on length of time of license usage per user checkout.
- Challenges overcome during the development of the Matlab Stats website include:
  - Parsing the Matlab log file both forward and backward to determine date of timestamps.
  - Calculating the time between a checkout and a check-in, where multiple checkouts were in progress for a single user.
- The Tools team will continue to enhance the Matlab Stats site to provide the most useful information for license management, and new sites will be developed for other licensed software, such as IDL and Tecplot.

**Mission Impact:** Better monitoring and management of scientific keyed licenses will help HECC users encounter fewer license denials, which reduces the impact on their work.



Matlab and Matlab toolbox license usage can now be graphed and better understood through detailed information provided on HECC's in-house Matlab Stats website.

**POC:** Ryan Spaulding, ryan.c.spaulding@nasa.gov, (408) 772-6567, NASA Advanced Supercomputing Division, ADNET Systems

# HECC Facility Passes Safety Audit with Flying Colors



- A team from NASA Ames' Occupational Safety, Health and Medical Services Division conducted a safety audit of the main supercomputing facility and associated facilities on the Ames campus.
- At the conclusion of the two-day audit, Ahleah Rohr Daniel, the safety audit team leader, said that she was very impressed and that we “run a tight ship.” The audit was part of the NASA Voluntary Protection Program.
- The audit team, working closely with HECC Facilities staff, conducted a thorough safety assessment of building N258 and rooms 189-190 in building N233A to ensure compliance with all NASA safety fire, materials, and electrical requirements.
- Findings from the audit are now 95% resolved, with the remaining findings awaiting procurements (for example, “Not an Exit” signs).
- During the audit, the safety team identified a best practice. HECC installed metal brackets and straps in the hallway to secure heavy equipment to the wall while it waits to be exercised.
- The results of the audit verify the HECC management and staff's commitment to safety.

**Mission Impact:** Working in a supercomputing environment poses a great number of potential safety hazards. By continually training, documenting, and raising safety awareness with staff, HECC is able to provide a safe working environment to NASA's most vital assets: its workforce.



The main computer room floor at the NASA Advanced Supercomputing facility, building N258, houses the agency's Pleiades supercomputer, the seventh most powerful system in the United States.

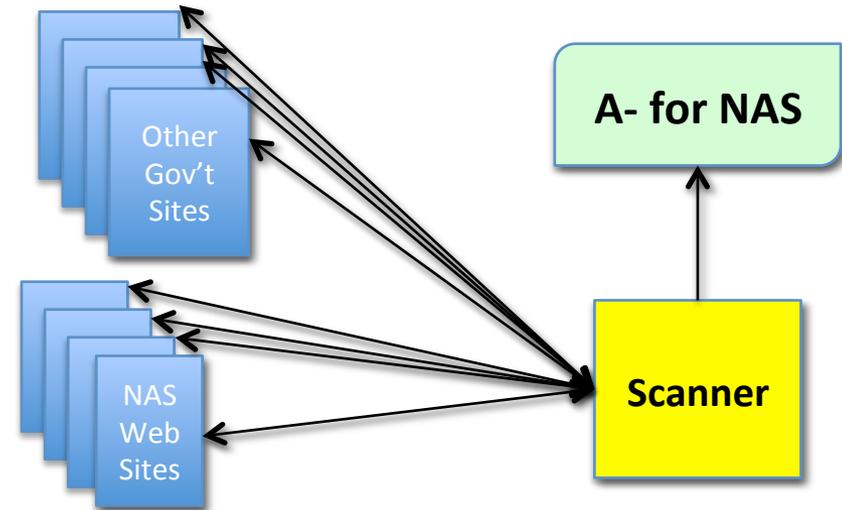
**POCs:** Ana Grady-Hiser, [ana.l.grady-hiser@nasa.gov](mailto:ana.l.grady-hiser@nasa.gov), (650) 604-4607, NASA Advanced Supercomputing (NAS) Division;  
Chris Buchanan, [chris.buchanan@nasa.gov](mailto:chris.buchanan@nasa.gov), (650) 604-4308, NAS Division, CSRA LLC

# Web Servers Found to be Configuration-Compliant by Government-Sponsored Scan



- The Senior Agency Information Security Officer (SAISO) for NASA congratulated HECC's security and system administration efforts with the following statement:  
**NAS web servers are reporting an awesome configuration with a 'Pulse' score of 'A-'.**
- Pulse is a U.S. government project to measure how well government sites are following best practices for federal websites.
- The "awesome" compliment is an important indicator that our personnel take the security of computational resources seriously, and work hard and effectively to ensure that they follow best practices in all aspects of system administration, in this case, web servers and websites.

**Mission Impact:** Recognition from NASA's Senior Agency Information Security Officer that HECC is meeting requirements for website server configuration best practices reflects the technical staff's expertise and commitment to ensure that NASA systems are securely configured to resist attack.



Scanning sponsored by the federal government covers federal sites to assess how well they meet best practices, in this case, for HECC websites.

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# ESS Team Completes Rollout of PIV Authentication on Yosemite Using Centrify



- To meet NASA's requirement for multi-factor authentication on user systems, HECC's Engineering Servers and Services (ESS) team completed the rollout of the Personal Identity Verification (PIV) smartcard authentication on Yosemite Macs using the Centrify software.
- ESS worked through issues to stabilize PIV authentication on OS X 10.10 Yosemite, including:
  - Overcame lockouts caused by a race condition between wireless networks and the Centrify login window by forcing an Ethernet network setting on boot.
  - Defined a process for users to use NDC credentialed logins in case of a lost badge.
  - Developed code to change the FileVault password for the boot accounts.
  - Defined a process for the HECC Control Room to issue a temporary password at a login window to overcome a lockout problem when the user does not want to reboot a system. (This scenario, although tested, has not yet been needed.)
- ESS is working with the Identity, Credential and Access Management (ICAM) team to share information on our Centrify configuration to benefit ICAM's rollout of Centrify.

**Mission Impact:** HECC Macs meet the new NASA requirement for using PIV smartcard authentication for logins, and our experts are helping NASA's Identity, Credential, and Access Management team to work through the Centrify configuration for the rollout to all NASA Macs.

```
a8888b.
d888888b.
8P"YP"Y88
8|o||o|88
8' .88
8`.' Y8.
d/ `8b.
dP ` Y8b.
d8:' " `::88b
d8" 'Y88b
:8P ESS :888
8a. _a88P
./"Yaa_: .| `V|
\ YP" | `V|
/ \_...d|
\---...8888P`_.'

FileVault Password Updater
Version 1.1

FileVault password requirements:
* Minimum of 12 characters
* Contains 3 out of 4 character types
- Uppercase, Lowercase, Symbol, Number

Press RETURN after each password entry

Last Successful Password Change:
None

Enter CURRENT FileVault password:
Enter NEW FileVault password:
Confirm NEW FileVault password:
```

The boot account password for authenticating to FileVault is managed by the "Boot Password Update" application developed by the HECC Engineering Servers and Services team.

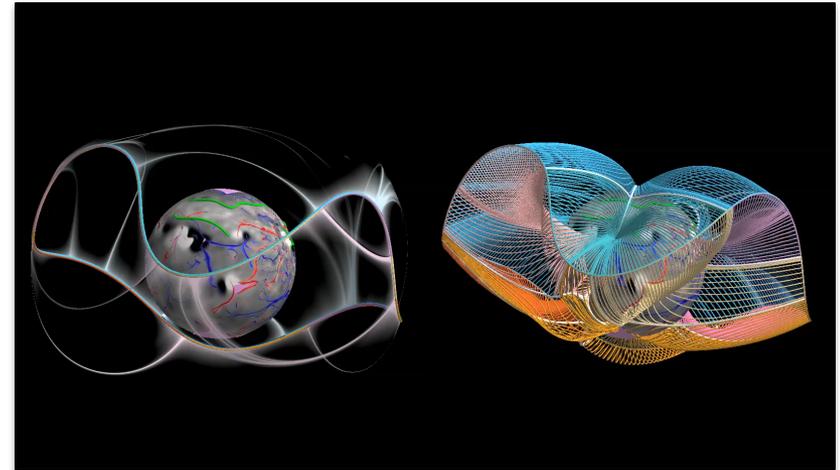
**POCs:** Ted Bohrer, [theodore.w.bohrer@nasa.gov](mailto:theodore.w.bohrer@nasa.gov), (650) 604-4335, Ed Garcia, [edmund.a.garcia@nasa.gov](mailto:edmund.a.garcia@nasa.gov), (650) 604-1338, NASA Supercomputing Division, ADNET Systems

# Pleiades Simulations Help Researchers Unlock the Secrets of Solar Storms \*



- Heliophysicists are running innovative simulations on Pleiades to investigate the structure and evolution of solar storms, with the ultimate goal of contributing to the development of predictive capabilities. Advancements include:
  - Developing new methods for producing pre-eruptive magnetic field structures, including analytic flux-rope models embedded in observed magnetograms.
  - Validating the behavior of eruptive events using the simulation code Magneto-hydrodynamic Algorithm outside a Sphere (MAS).
  - Simulating in detail one of the largest solar storms ever recorded, the Bastille Day event of July 14, 2000, which produced a blast exceeding 1,700 kilometers per second.
  - Enabling researchers around the globe to run simulations online using the MAS code via NASA's Community Coordinated Modeling Center (CCMC).
- By providing insight into the underlying nature of solar storms, the simulations will help to develop methods of predicting these events in order to mitigate damage to critical infrastructure such as satellites, communications, and power grids.

**Mission Impact:** Simulations made possible by HECC resources are helping researchers understand the structure and evolution of solar storms, which is vital to developing the ability to predict the storms and their trajectories—a major goal of NASA's Heliophysics Research Program.



Topological structure of the source-surface potential magnetic field in the Sun's corona, computed from magnetic data collected August 1-2, 2010. Left: The squashing-factor ( $Q$ ) distribution at the source surface. Right: The helmet-streamer dome.

**POCs:** Ronald Caplan, [caplanr@predsci.com](mailto:caplanr@predsci.com), (858) 225-2314; Zoran Mikić, [mikicz@predsci.com](mailto:mikicz@predsci.com), (858) 450-6493, Predictive Science, Inc.

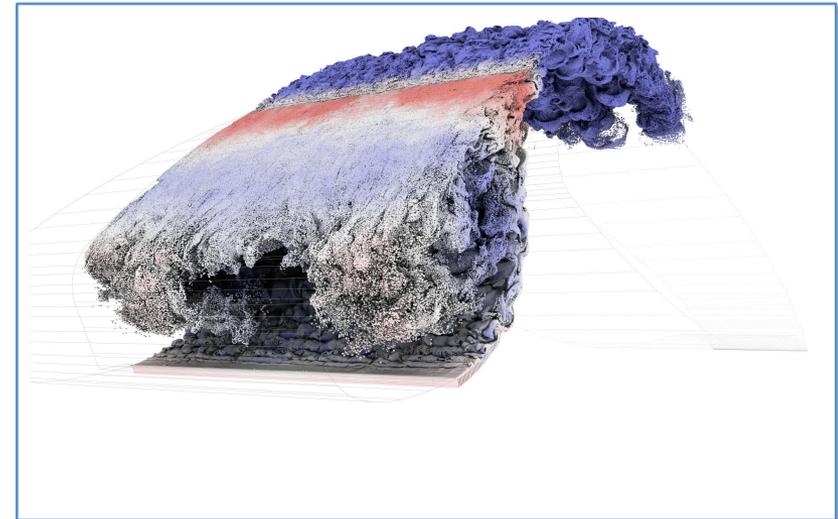
\* HECC provided supercomputing resources and services in support of this work

# Numerical Simulation of Slat Noise Supports Environmentally Responsible Aviation \*



- Computational fluid dynamics (CFD) experts at NASA Ames ran high-fidelity, time-accurate numerical simulations on Pleiades to understand the underlying physics of aircraft wing slat noise that affects communities near airports.
- An experimental test was also performed in the Quiet Flow Facility (QFF) at NASA Langley to validate the computed results of the acoustic simulations.
- The simulations were generated using the NAS Division's in-house Launch Ascent and Vehicle Aerodynamics (LAVA) solver framework, and support NASA's Environmentally Responsible Aviation (ERA) project.
- LAVA CFD analysis was used exclusively to help the design the QFF experiment.
- Impacts on ERA include:
  - Validation of LAVA for predicting noise generation and sound propagation from high-lift devices.
  - A successful experimental test resulting from strong cross-center collaboration between Ames and Langley.
  - A high-fidelity dataset to explore the noise-generating mechanism for a deeper understanding of slat noise.
- Each simulation used 500 cores and 62,000 core hours on Pleiades, which will be also used for acoustic simulations to explore differences in noise generation between the slat and another lift-device, the leading-edge Krueger flap.

**Mission Impact:** Simulations enabled by HECC resources support investigations of noise-reduction concepts for next-generation commercial aircraft, as part of NASA's Environmentally Responsible Aviation project.



Front view of passive particles, colored by pressure, showing the impingement of an aircraft slat leading-edge wake onto the lower surface of the slat. Acoustic pressure waves are observed as the particles repeatedly impact the slat surface. This impingement of the wake onto the slat surface is the dominant source of broadband noise generated by the high-lift device on the aircraft. *Jeffrey Housman, Timothy Sandstrom, NASA Ames.*

**POC:** Cetin Kiris, [cetin.c.kiris@nasa.gov](mailto:cetin.c.kiris@nasa.gov), (650) 604-4485, NASA Advanced Supercomputing Division

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

# HECC Facility Hosts Several Visitors and Tours in June 2016



- HECC hosted 15 tour groups in June; guests learned about the agency-wide missions being supported by HECC assets, and some groups also viewed the D-Wave 2X quantum computer system.

Visitors this month included:

- Dava Newman, NASA deputy administrator, was interviewed for the Fox Network Saturday morning education program while visiting the HECC facility.
- NASA 2016 Agency Honor Award distinguished honorees and their families visited the facility after the ceremony held at Ames; Greg Williams, deputy associate administrator for HEOMD, was one of the guests.
- Members of the Aerospace Safety Advisory Panel.
- Maros Sefcovic, vice president of the European Commission.



Piyush Mehrotra, Chief, NASA Advanced Supercomputing Division, gave an overview of the work being done at the NAS facility to NASA Honor Award recipients and their guests, and described work performed on the HECC Pleiades supercomputer.

**POC:** Gina Morello, [gina.f.morello@nasa.gov](mailto:gina.f.morello@nasa.gov), (650) 604-4462, NASA Advanced Supercomputing Division



- **AIAA Aviation**, Washington D.C., June 13–17, 2016
  - **“Numerical Simulation of HIWC Conditions with the Terminal Area Simulation System,”** F. Proctor, G. Switzer. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-4203>
  - **“Design and Analysis of High Aspect Ratio Nozzles for Distributed Propulsion Acoustic Measurements,”** V. Dippold. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3876>
  - **“Multivariate Statistics Analysis of the Pressure Field Induced by High-Speed Turbulent Boundary Layers,”** C. Zhang, L. Duan. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3190>
  - **“Influence of Stationary Crossflow Modulation on Secondary Instability,”** M. Choudhari, et al. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3788>
  - **“Aerodynamic Modeling of Transonic Aircraft Using Vortex Lattice Coupled with Transonic Small Disturbance for Conceptual Design,”** D. Chaparro, et al. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3418>
  - **“LES Modeling of Scalar Transport Based on High-Order Discontinuous Finite-Element Method: Assessment of Implicit LES and Scalar Variance Modeling,”** Y. Lu, M. Ihme. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3799>
  - **“Computational Investigation of a Boundary-Layer Ingesting Propulsion System for the Common Research Model,”** B. Blumenthal, et al. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3812>

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



- **“To  $v_{\infty}$  and Beyond! The He I Absorption Variability Across the 2014.6 Periastron Passage of  $\eta$  Carinae,”** N. Richardson, et al., Monthly Notices of the Royal Astronomical Society, vol. 460, issue 1, June 15, 2016. \*  
*<http://mnras.oxfordjournals.org/content/early/2016/06/15/mnras.stw1415.abstract>*
- **“An Evaluation of the Parallel Ensemble Empirical Mode Decomposition Method in Revealing the Role of Downscaling Process Associated with African Easterly Waves in Tropical Cyclone Genesis,”** Y. Wu, B.-W. Shen, Journal of Atmospheric and Oceanic Technology, June 15, 2016. \*  
*<http://journals.ametsoc.org/doi/abs/10.1175/JTECH-D-15-0257.1>*
- **“Selection and Quality Assessment of Landsat Data for the North American Forest Dynamics Forest History Maps of the US,”** K. Schlieeweis, et al., International Journal of Digital Earth, June 20, 2016. \*  
*<http://www.tandfonline.com/doi/abs/10.1080/17538947.2016.1158876>*
- **“Supernova Driving. II. Compressive Ratio in Molecular-Cloud Turbulence,”** L. Pan, al., The Astrophysical Journal, vol. 825, no. 1, June 27, 2016. \*  
*<http://iopscience.iop.org/article/10.3847/0004-637X/825/1/30>*

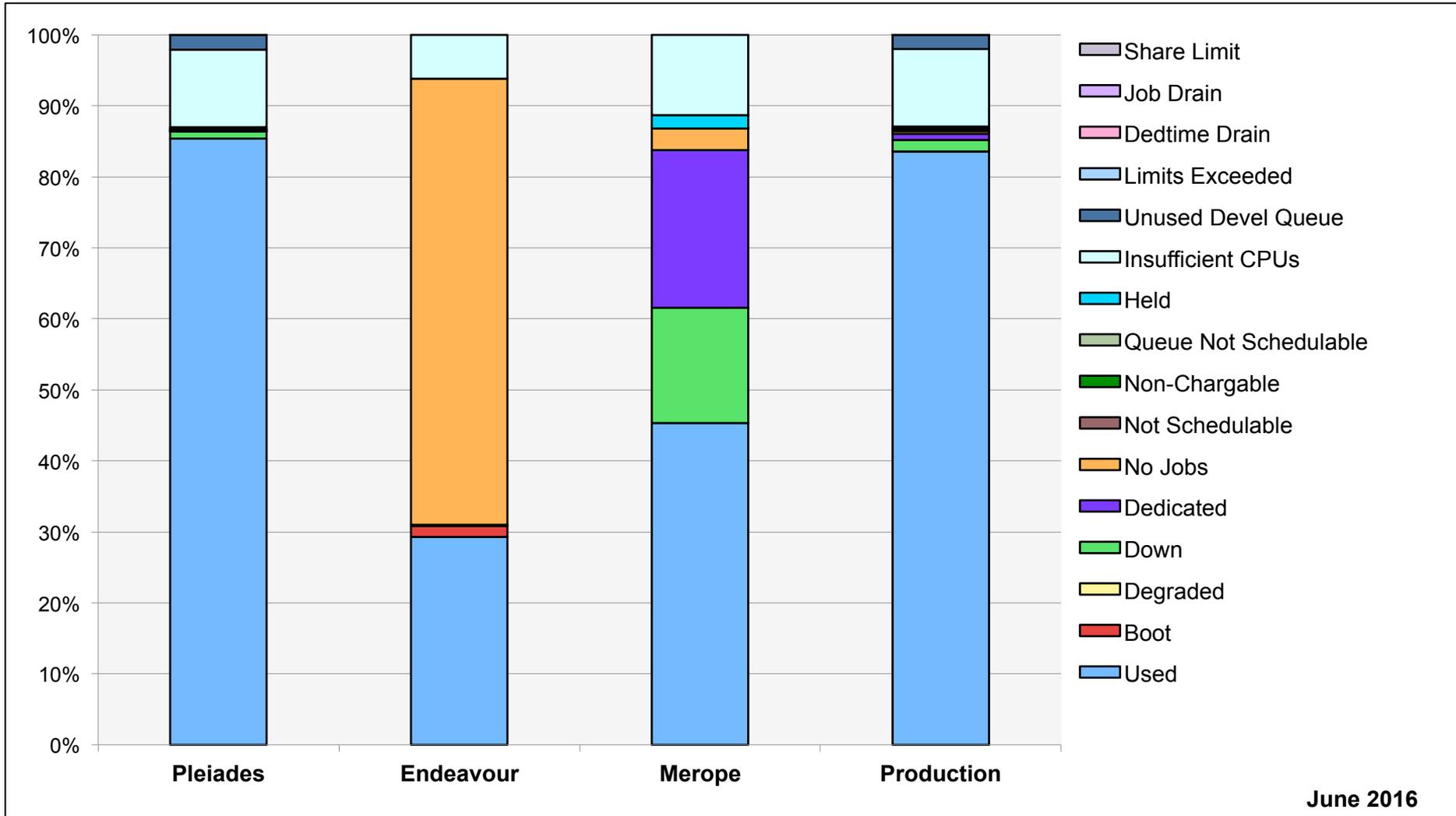


- **AIAA Aviation**, Washington D.C., June 13-17, 2016
  - **“Comparison of Viscous and Inviscid Loads in a Static Aeroelastic Model of the Variable Camber Continuous Trailing Edge Flap Concept in the Transonic Regime,”** M. Denison, J. Housman, E. Ting, N Nguyen. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3571>
  - **“Lift Optimization Study of a Multi-Element Three-Segment Variable Camber Airfoil,”** U. Kaul, N. Nguyen. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3569>
  - **“An Immersed Boundary Method for Solving the Compressible Navier-Stokes Equations with Fluid-Structure Interaction,”** C. Brehm, M. Barad, C. Kiris. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3265>
  - **“Stability Analysis of Dual-Time Stepping,”** J. Chiew, T. Pulliam. \*  
<http://arc.aiaa.org/doi/10.2514/6.2016-3963>
- **“Merging Big Data and HPC for Large-Scale Analysis/Analytics at the NASA Advanced Supercomputing (NAS) Division,”** P. Mehrotra, J. Becker, presented at Big Data and Extreme-Scale Computing, Frankfurt, Germany, June 15–17, 2016.  
<http://www.exascale.org/bdec/sites/www.exascale.org.bdec/files/whitepapers/mehrotra-BDEC%202016.pdf>
- **“Quantum Computing: Status and Outlook,”** R. Biswas, Invited Talk at 28th High Performance Consortium for Advanced Scientific and Technical Computing (HP-CAST), Frankfurt, Germany, June 17–18, 2016.
- **“Quantum Computing at NASA: Challenges and Opportunities,”** R. Biswas, Distinguished Lecture at ISC High Performance Conference, Frankfurt, Germany, June 20–23, 2016.



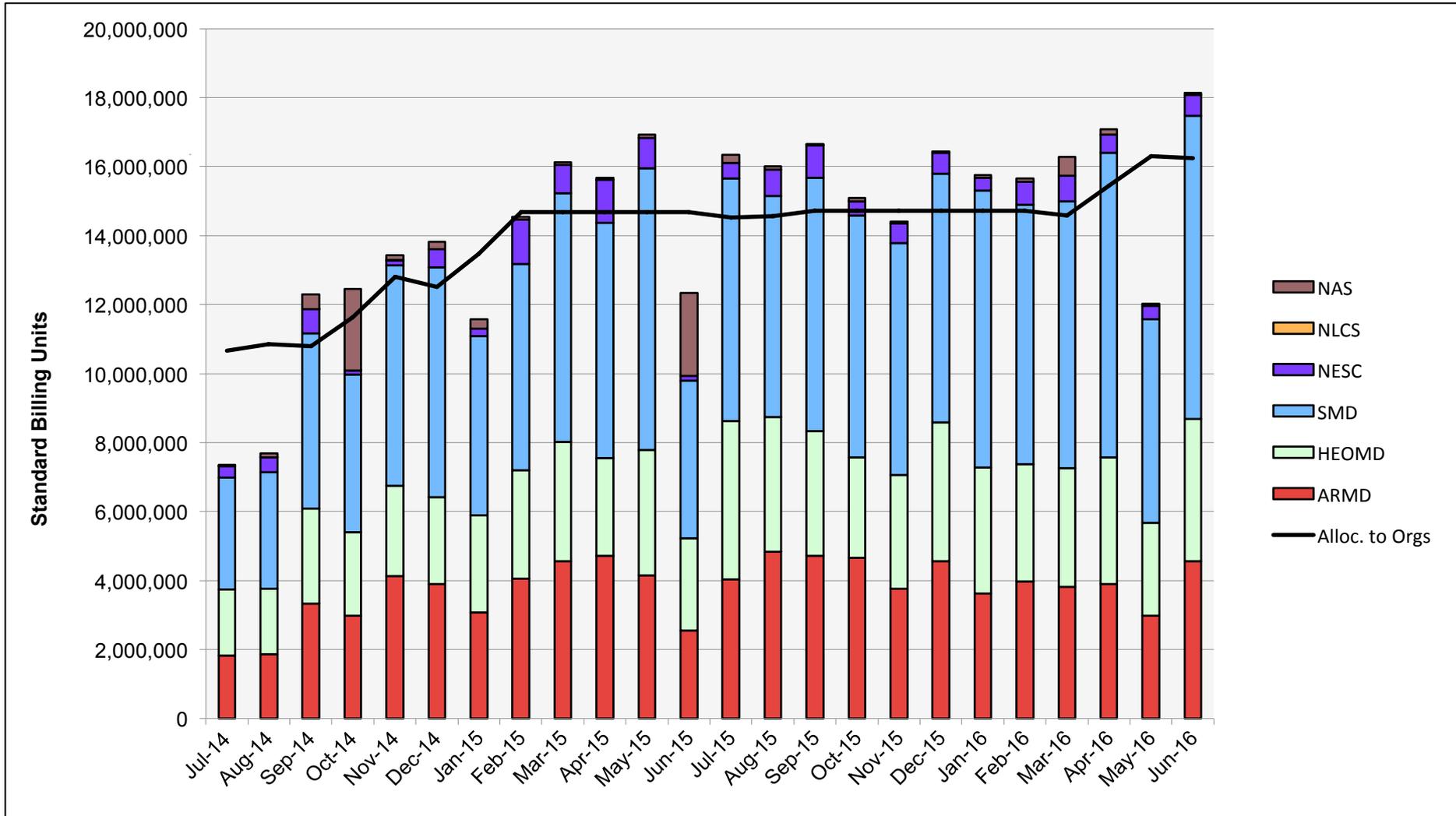
- **Pleiades Supercomputer Tops Six Petaflops, Long-Term Storage Capacity Tripled**, *NAS News*, June 1, 2016—NASA's flagship supercomputer received a hardware boost that pushed the system's computing capability to 6.28 petaflops. Additionally, the Spectra Logic mass storage system at the NAS facility was expanded to provide nearly half an exabyte of data storage to users (with compression).  
<http://www.nas.nasa.gov/publications/news/2016/06-01-16.html>
- **Pleiades Supercomputer Tops Six Petaflop/s, Long-Term Storage Capacity Tripled**, *Primeur Magazine*, June 1, 2016.  
<http://primeurmagazine.com/weekly/AE-PR-07-16-6.html>

# HECC Utilization

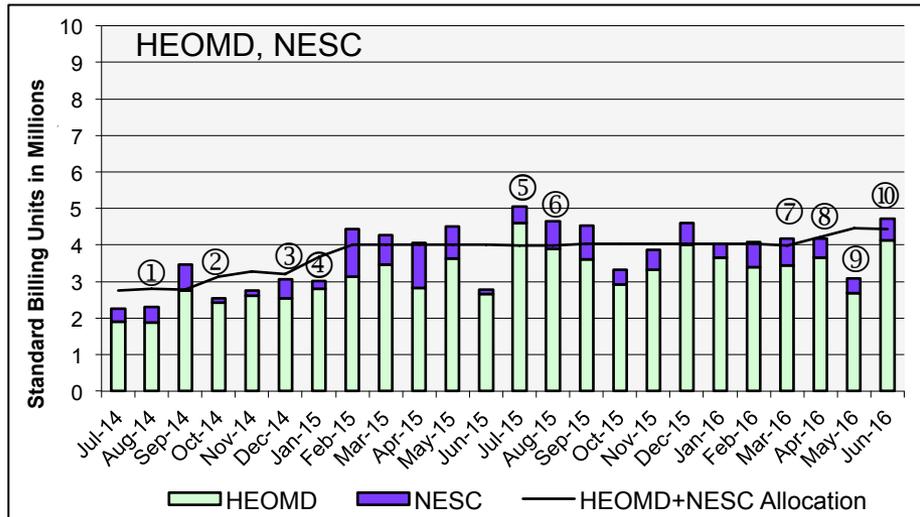
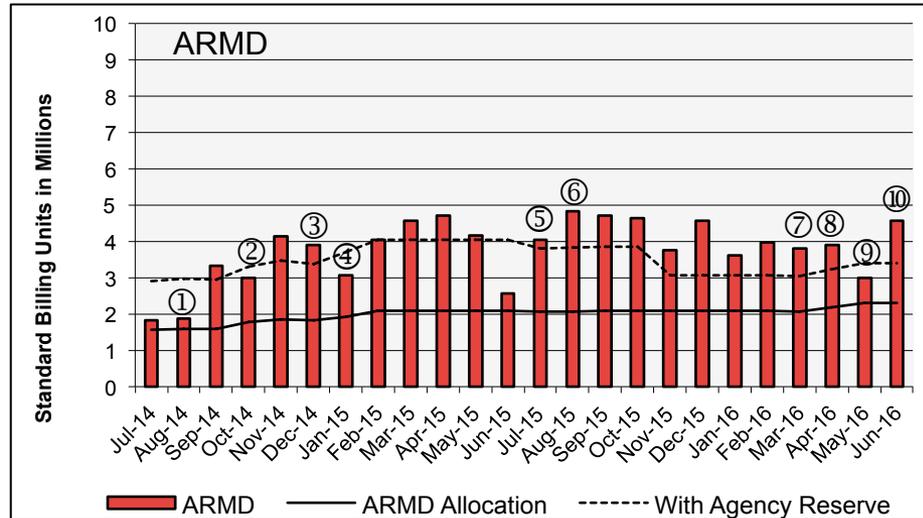
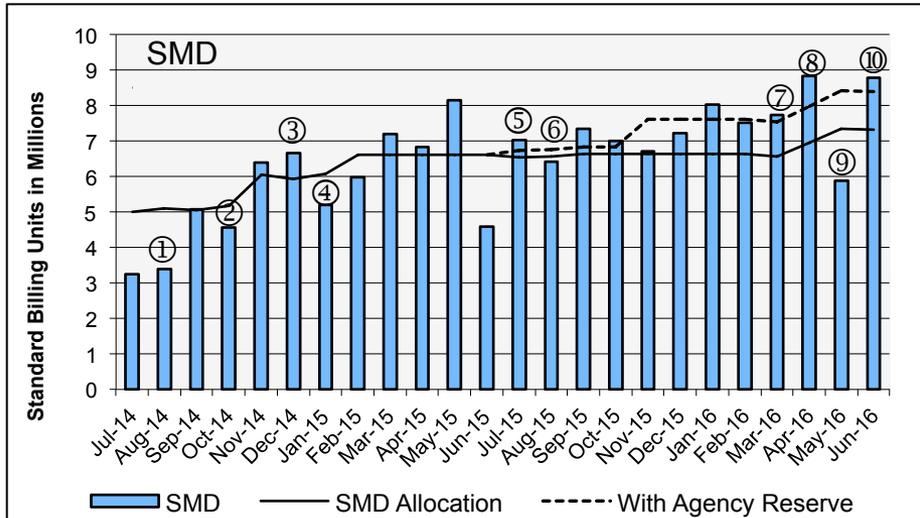


June 2016

# HECC Utilization Normalized to 30-Day Month

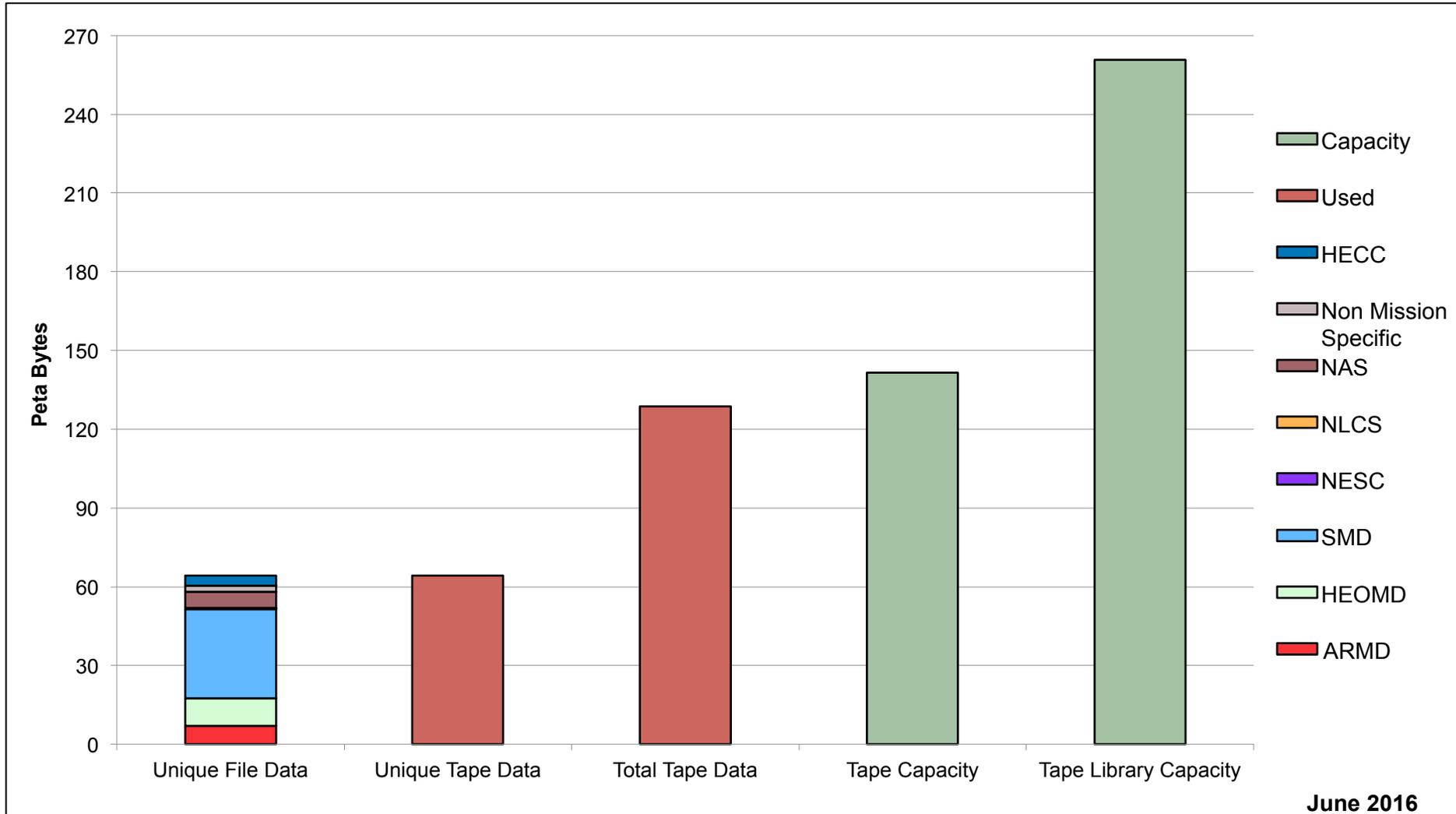


# HECC Utilization Normalized to 30-Day Month



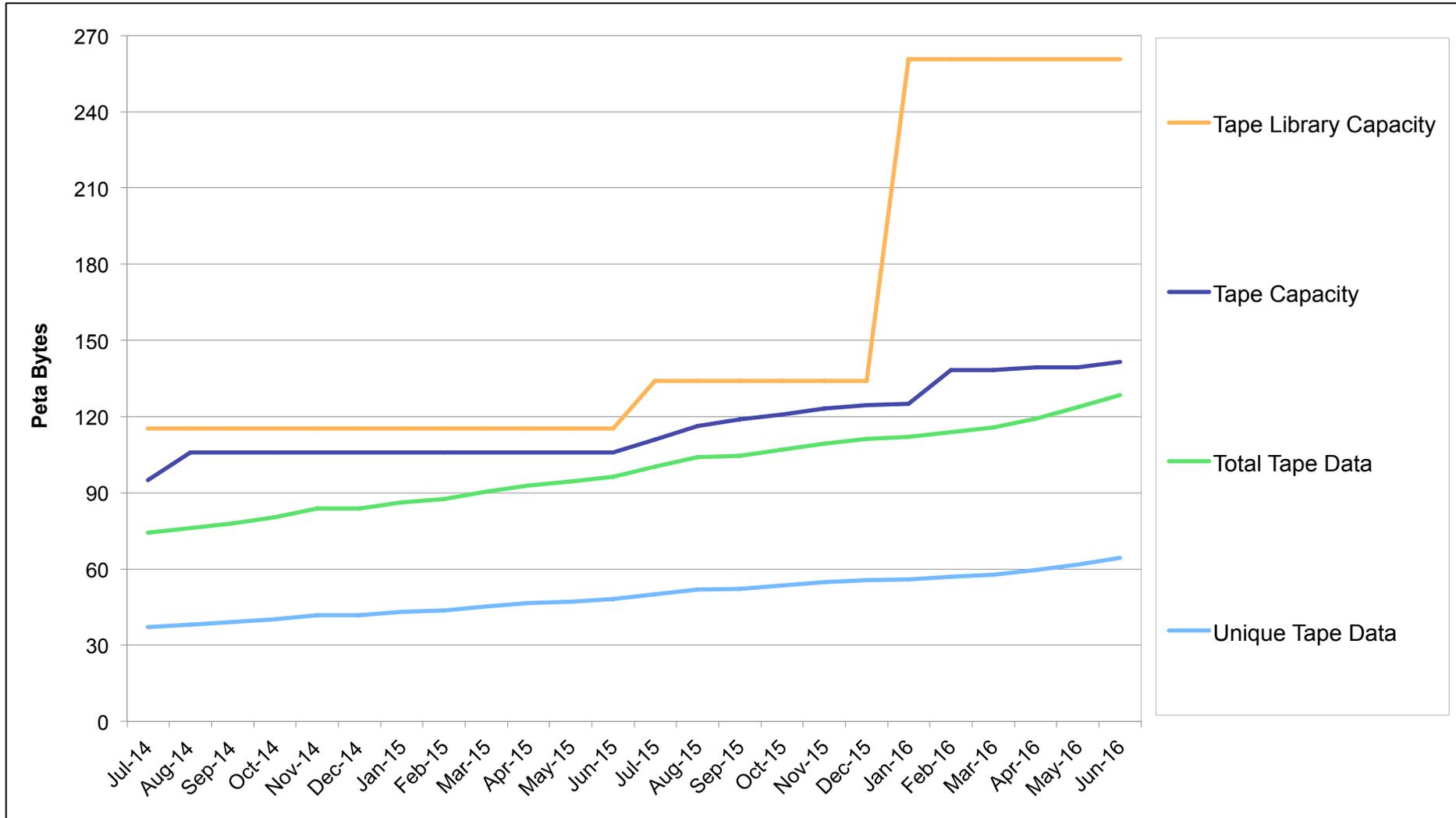
- ① 6 Westmere ½ racks added to Merope, 6 Harpertown ½ racks retired from Merope
- ② 16 Westmere racks retired from, 3 Ivy Bridge and 15 Haswell racks added to Pleiades; 10 Nehalem and 2 Westmere racks added to Merope
- ③ 16 Westmere racks retired from Pleiades
- ④ 14 Haswell racks added to Pleiades
- ⑤ 7 Nehalem ½ racks retired from Merope
- ⑥ 7 Westmere ½ racks added to Pleiades
- ⑦ 16 Westmere racks retired from Pleiades
- ⑧ 10 Broadwell racks added to Pleiades
- ⑨ 4 Broadwell racks added to Pleiades
- ⑩ 14 (all) Westmere racks retired from Pleiades

# Tape Archive Status

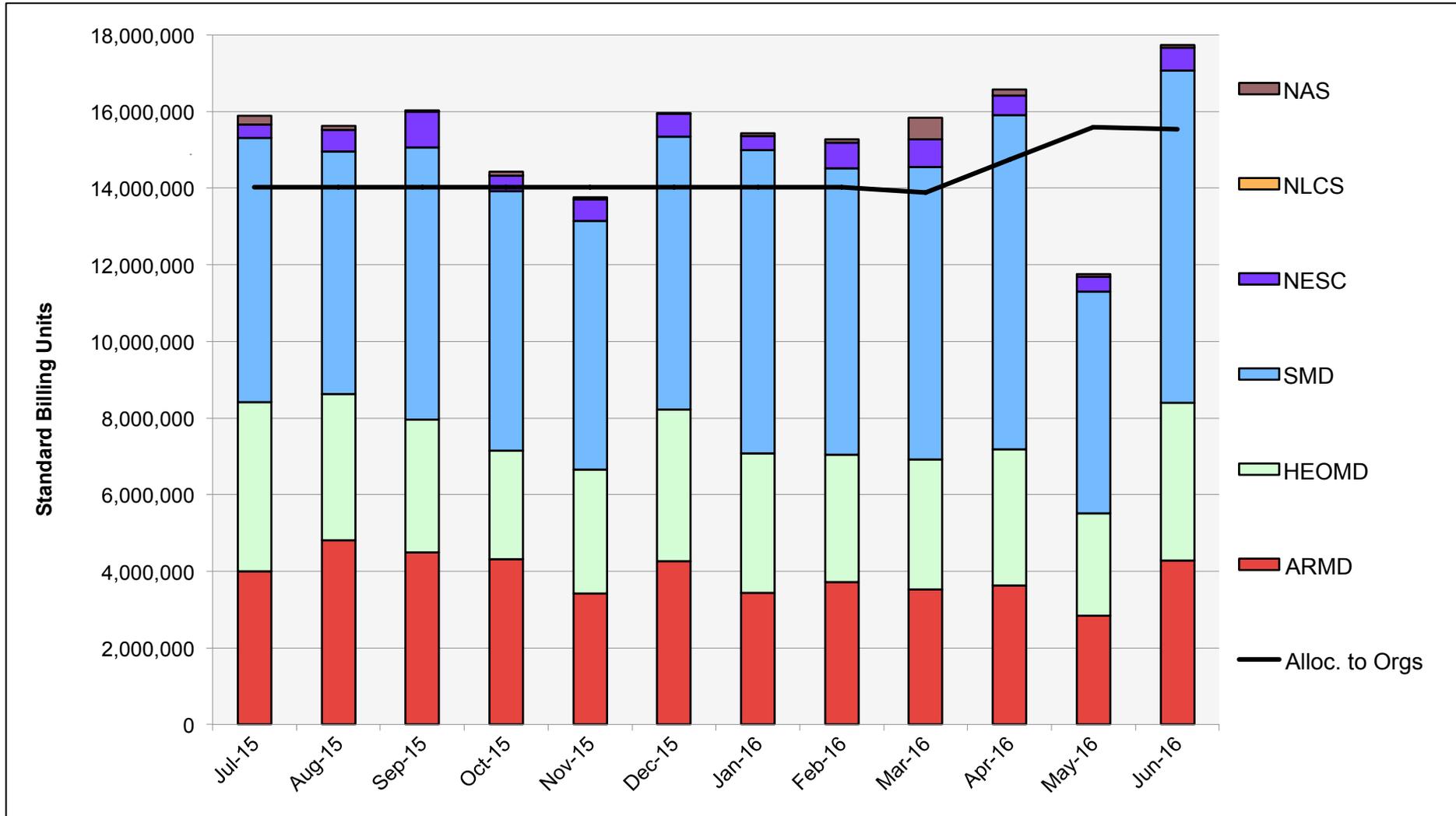


June 2016

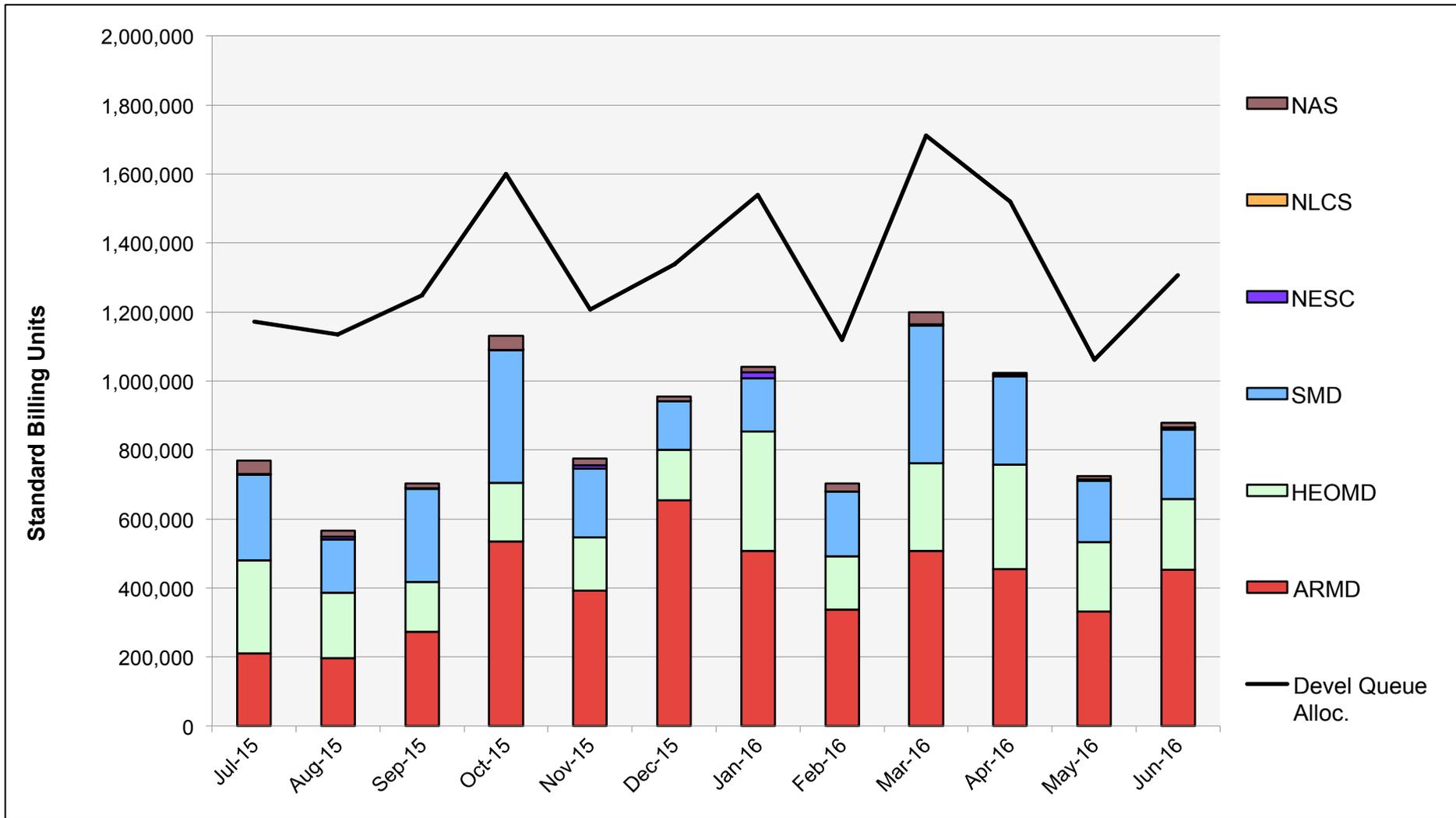
# Tape Archive Status



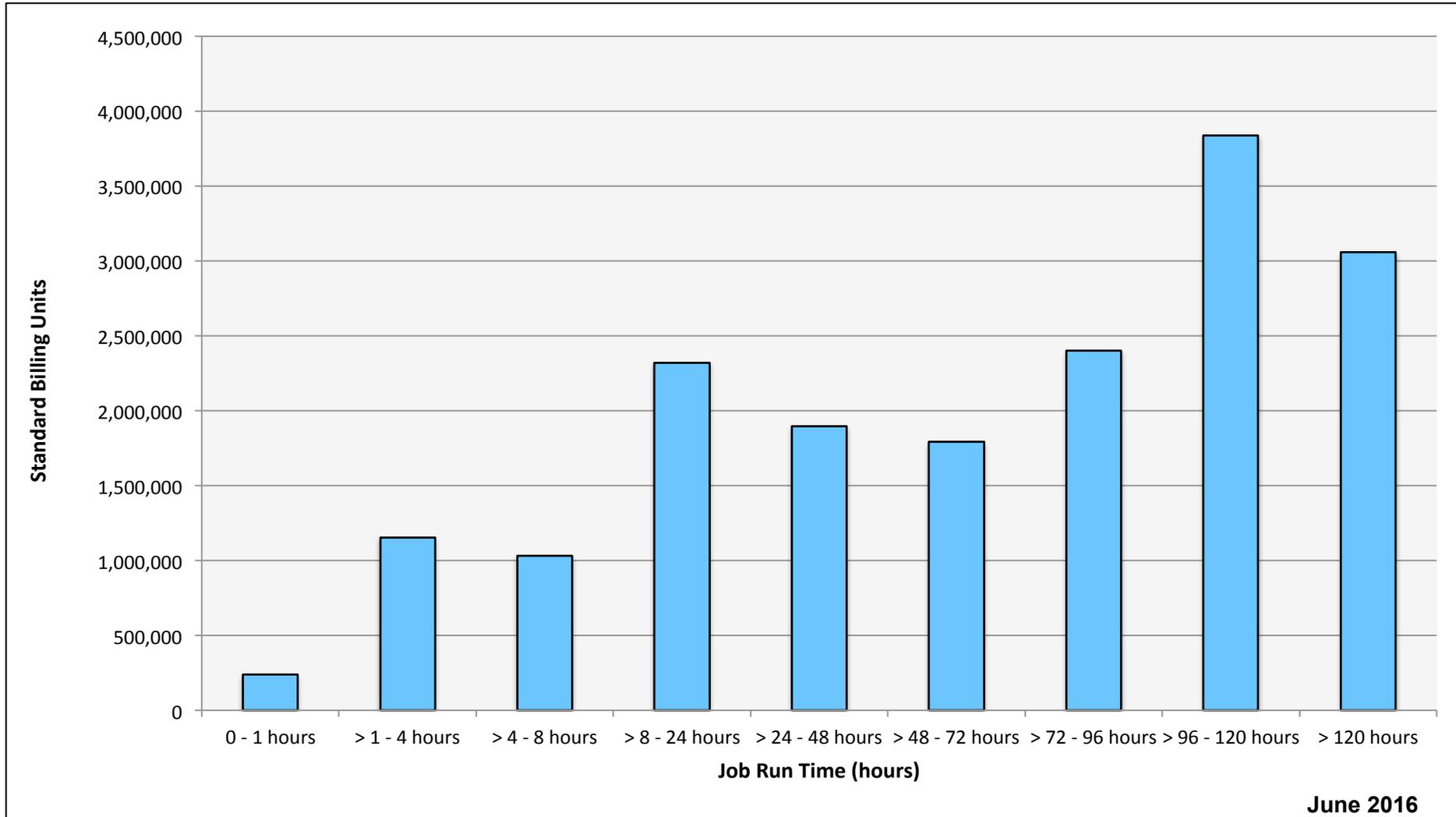
# Pleiades: SBUs Reported, Normalized to 30-Day Month



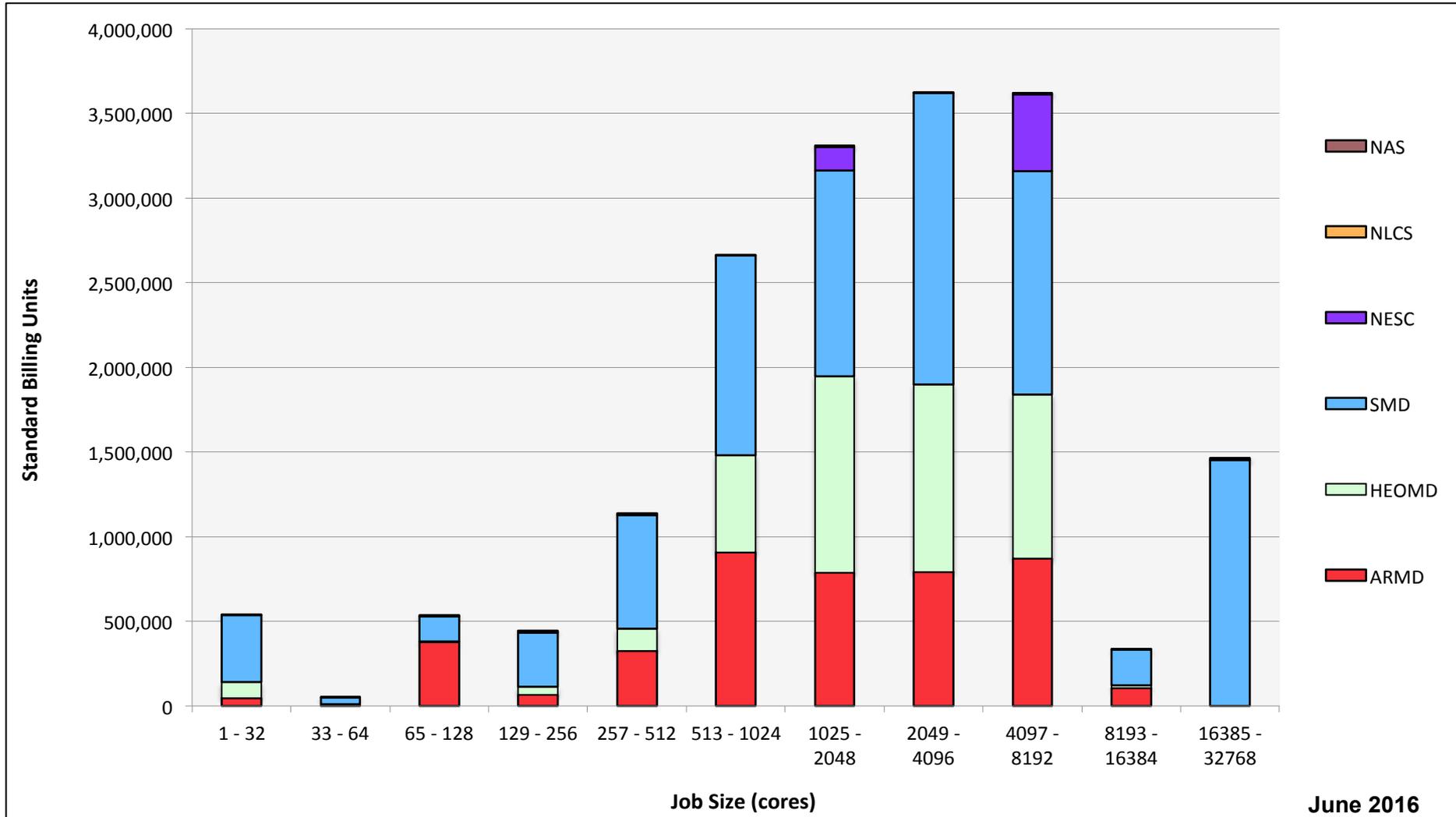
# Pleiades: Devel Queue Utilization



# Pleiades: Monthly Utilization by Job Length

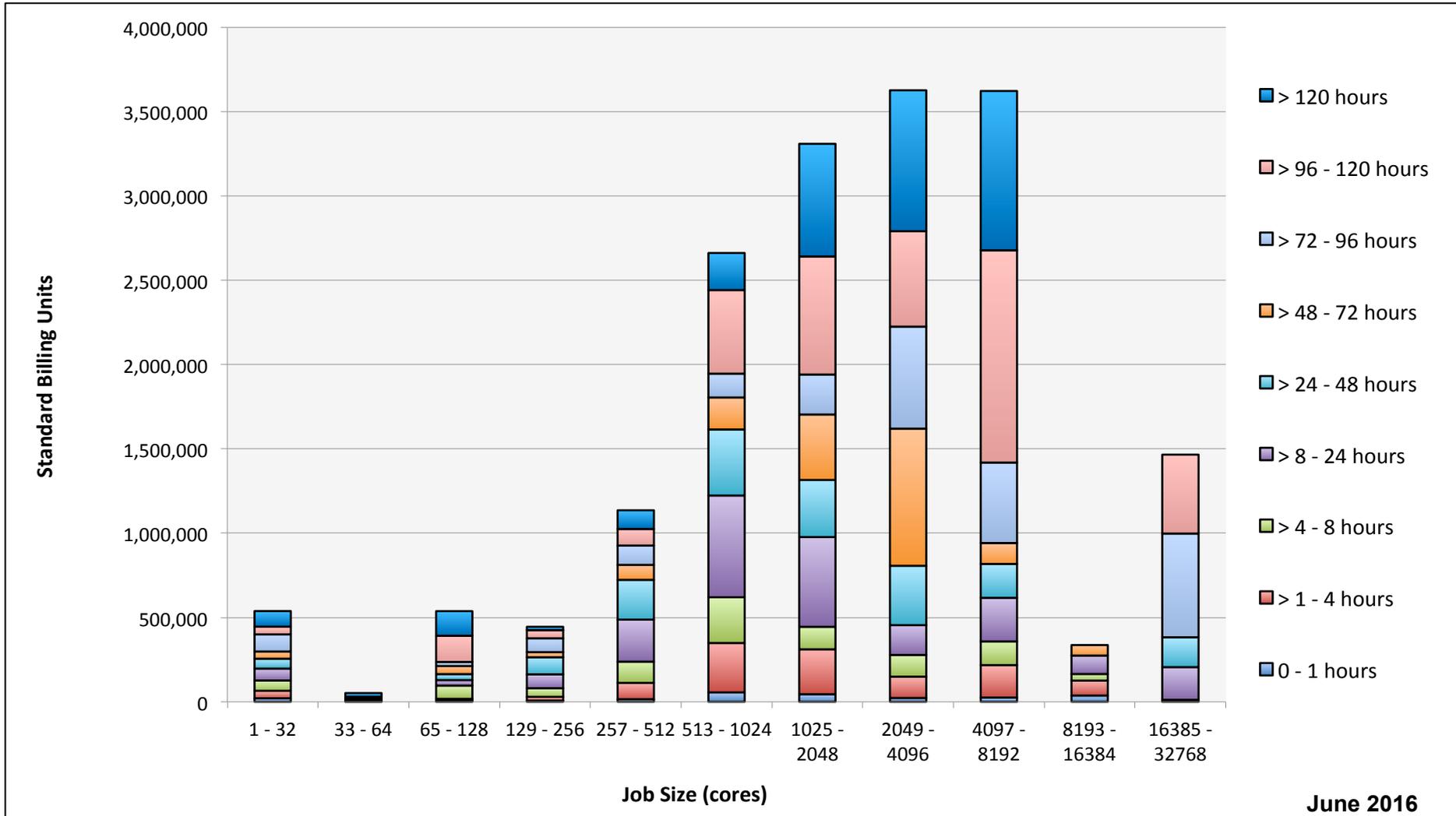


# Pleiades: Monthly Utilization by Size and Mission



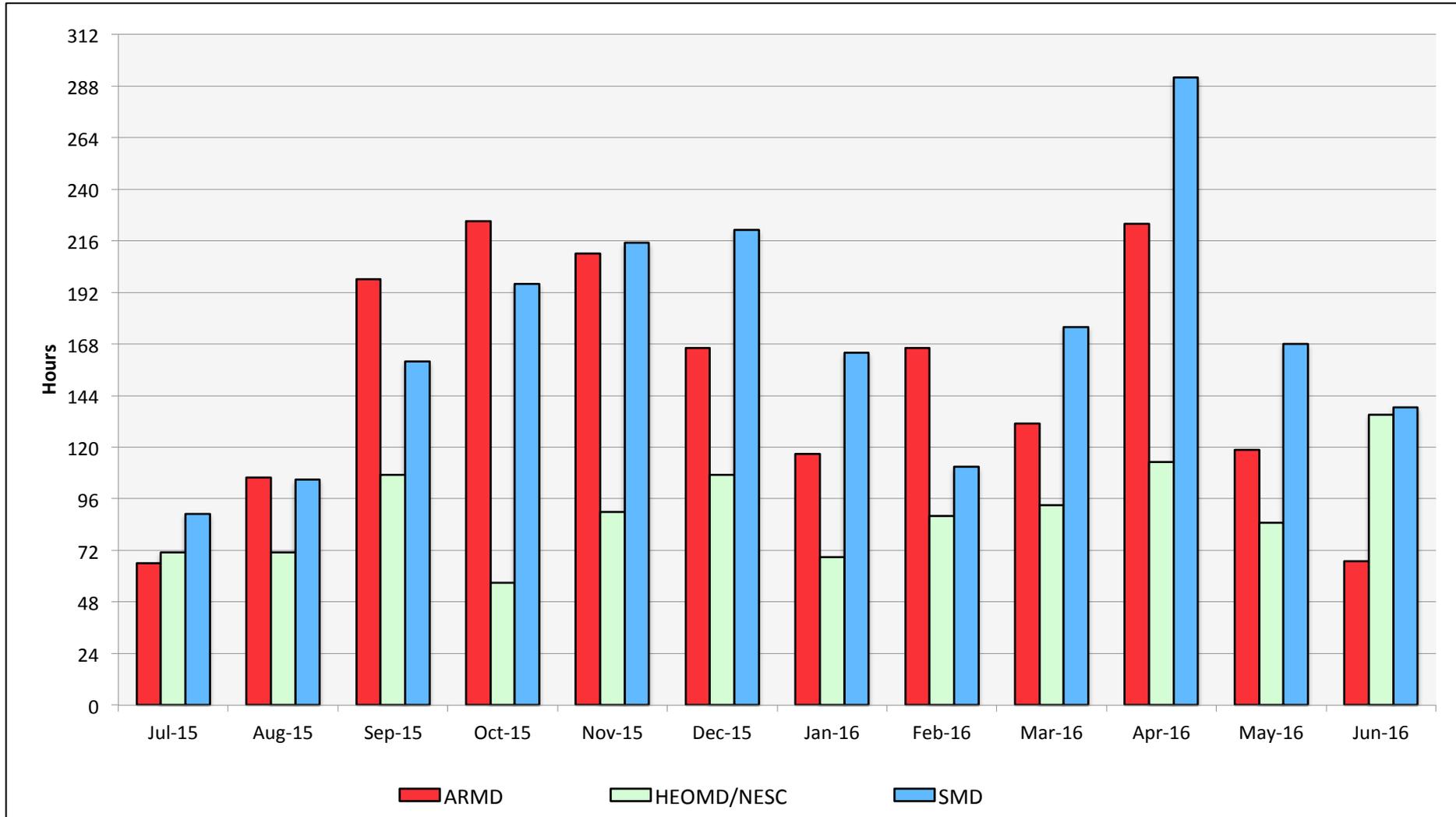
June 2016

# Pleiades: Monthly Utilization by Size and Length

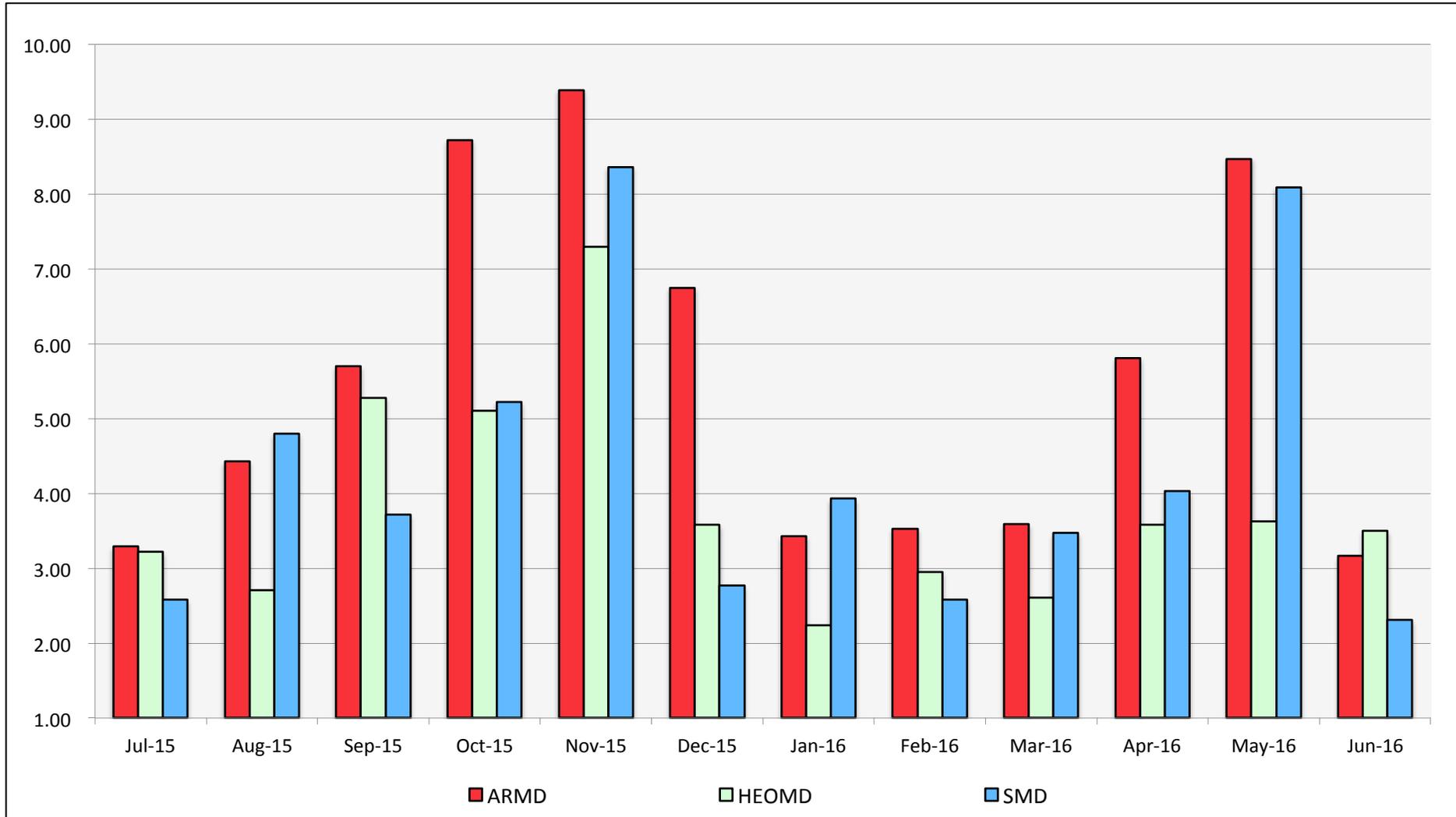


June 2016

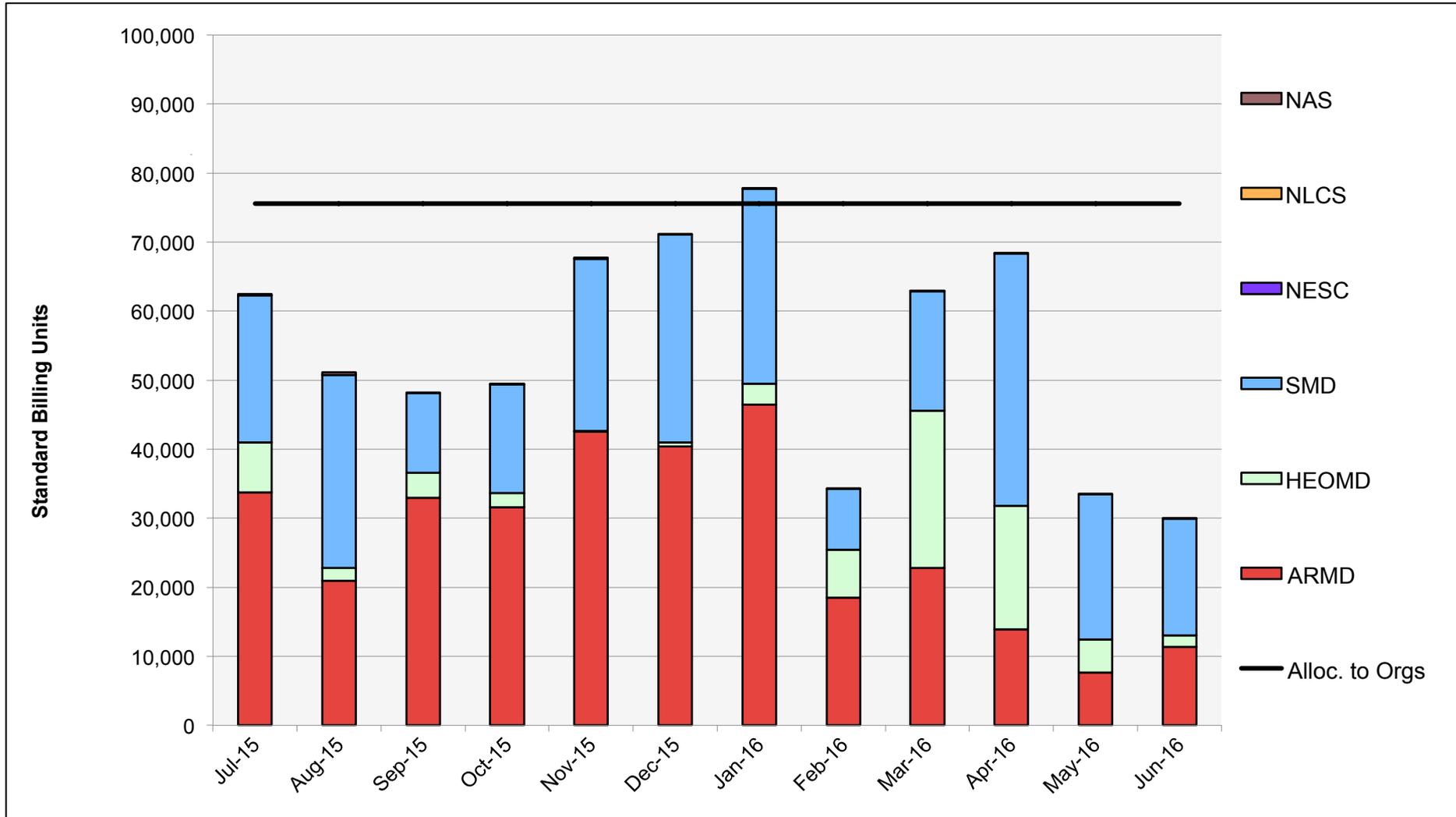
# Pleiades: Average Time to Clear All Jobs



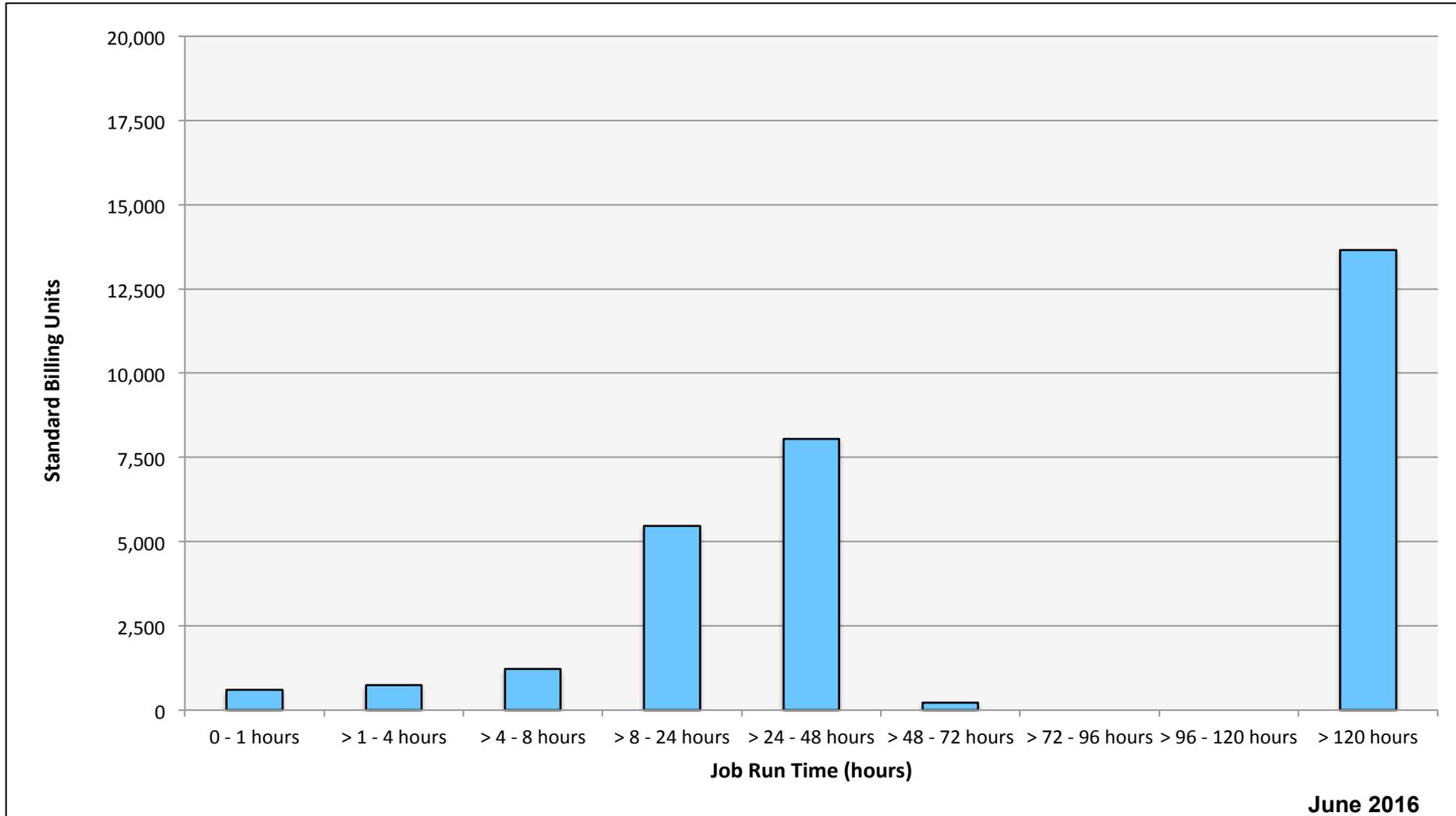
# Pleiades: Average Expansion Factor



# Endeavour: SBUs Reported, Normalized to 30-Day Month

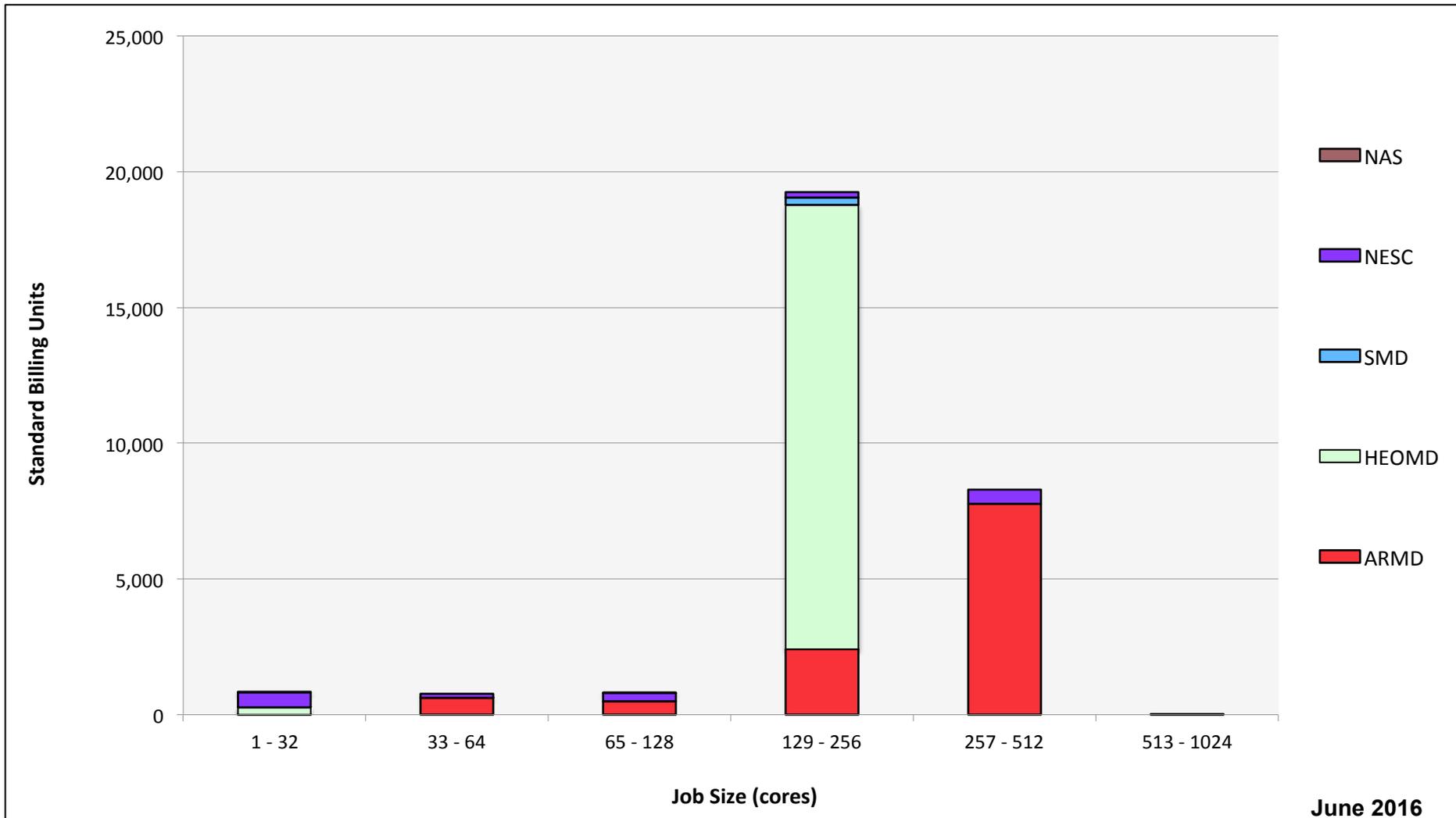


# Endeavour: Monthly Utilization by Job Length



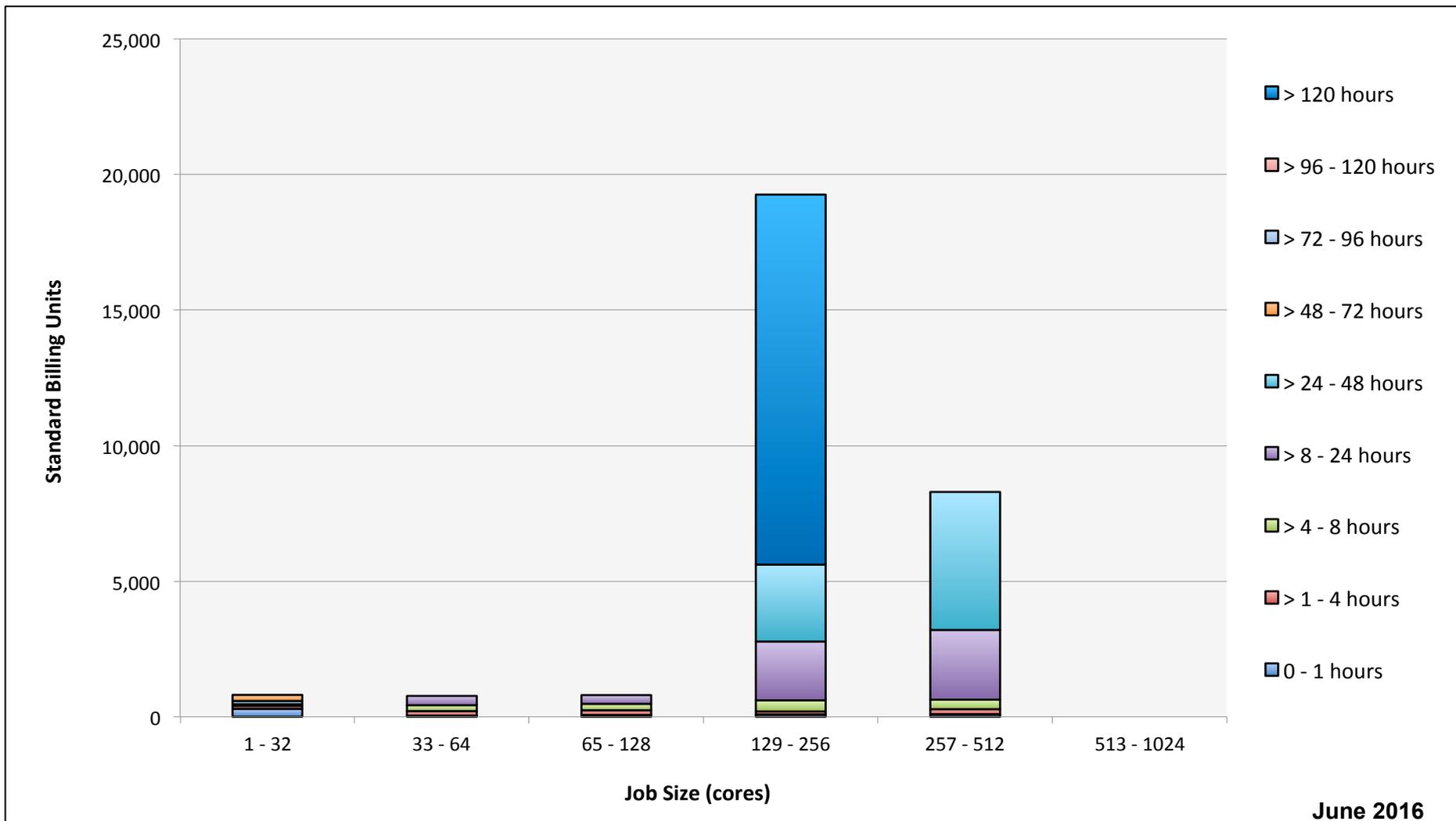
June 2016

# Endeavour: Monthly Utilization by Size and Mission

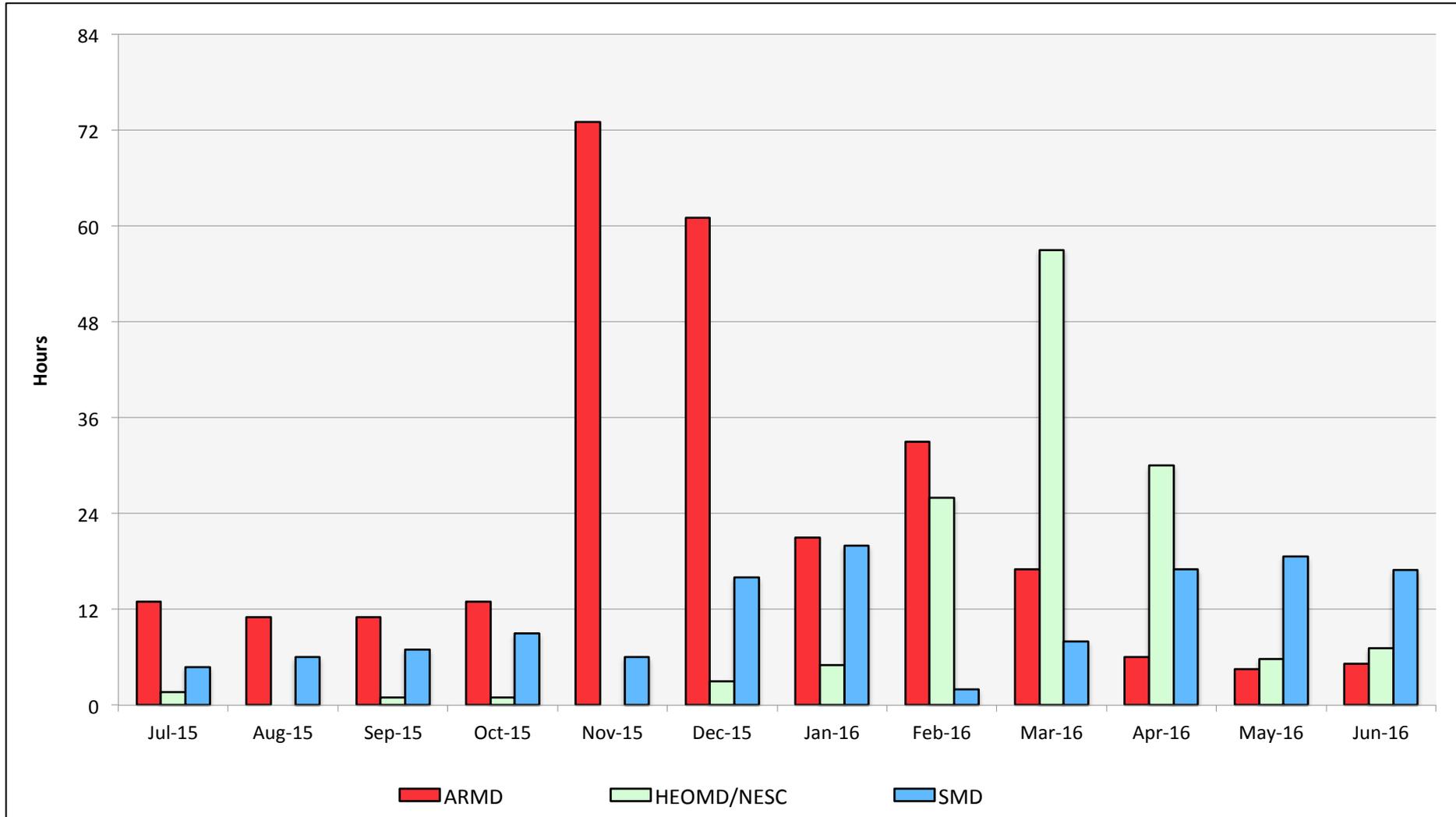


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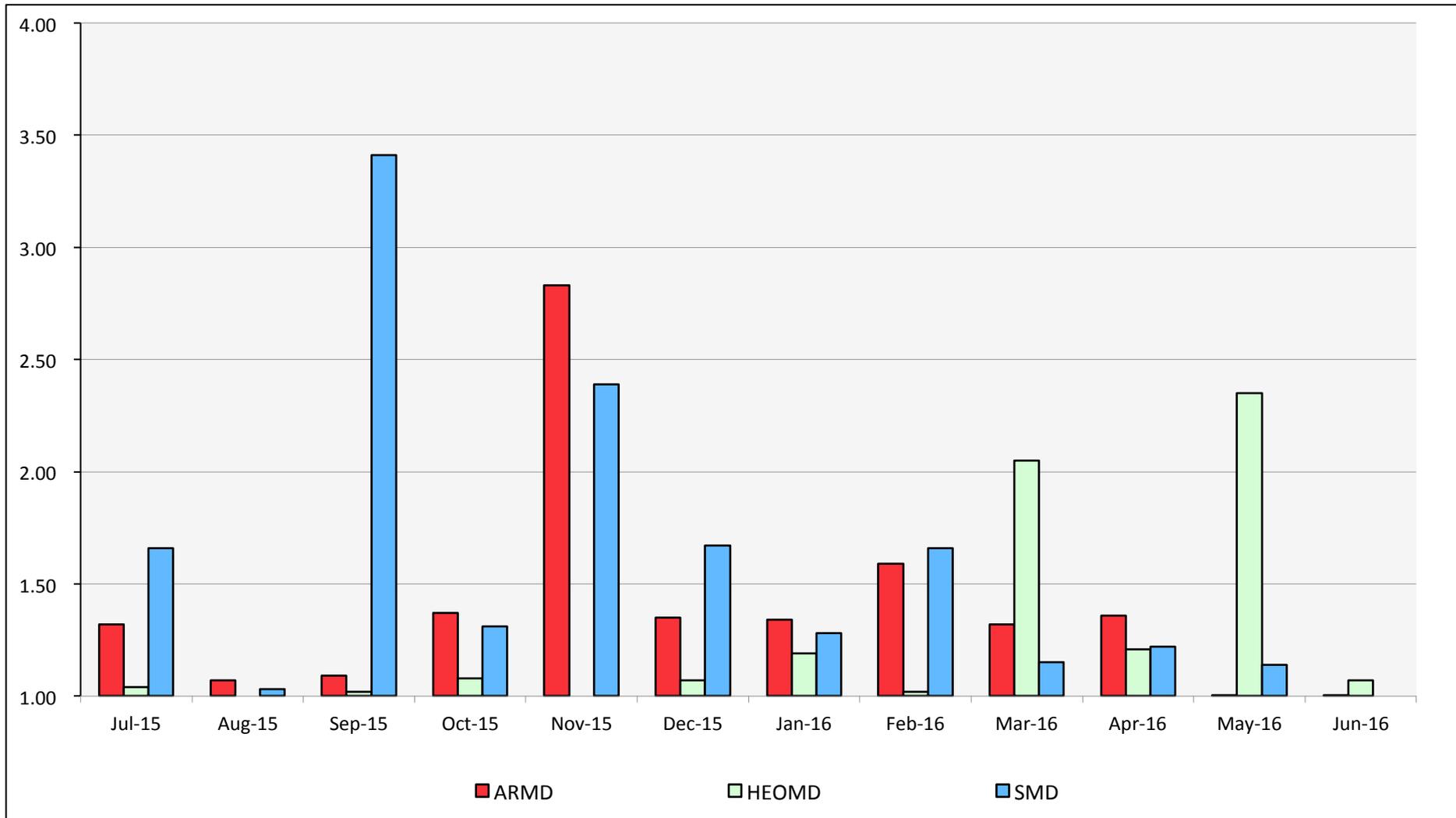
# Endeavour: Monthly Utilization by Size and Length



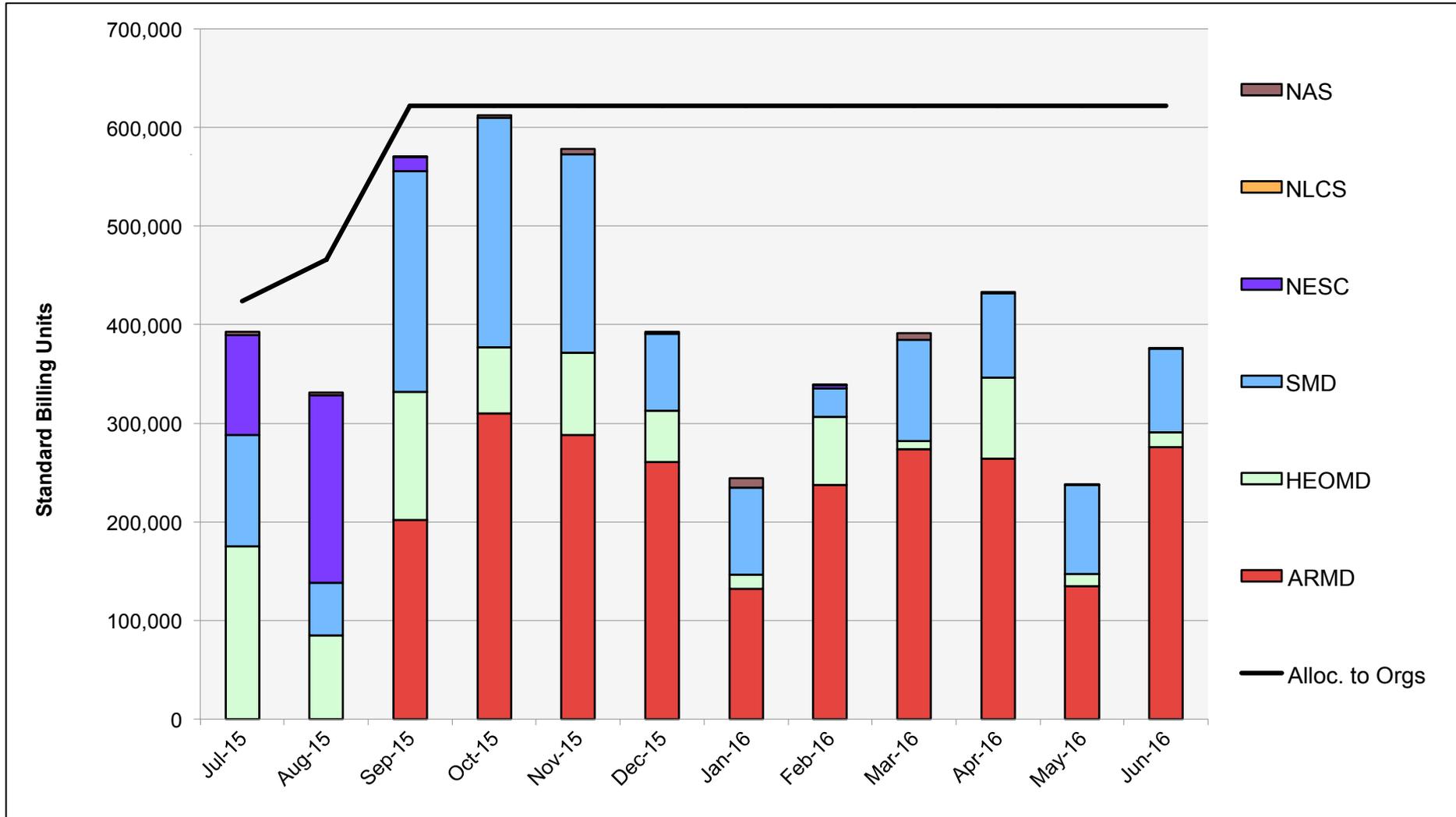
# Endeavour: Average Time to Clear All Jobs



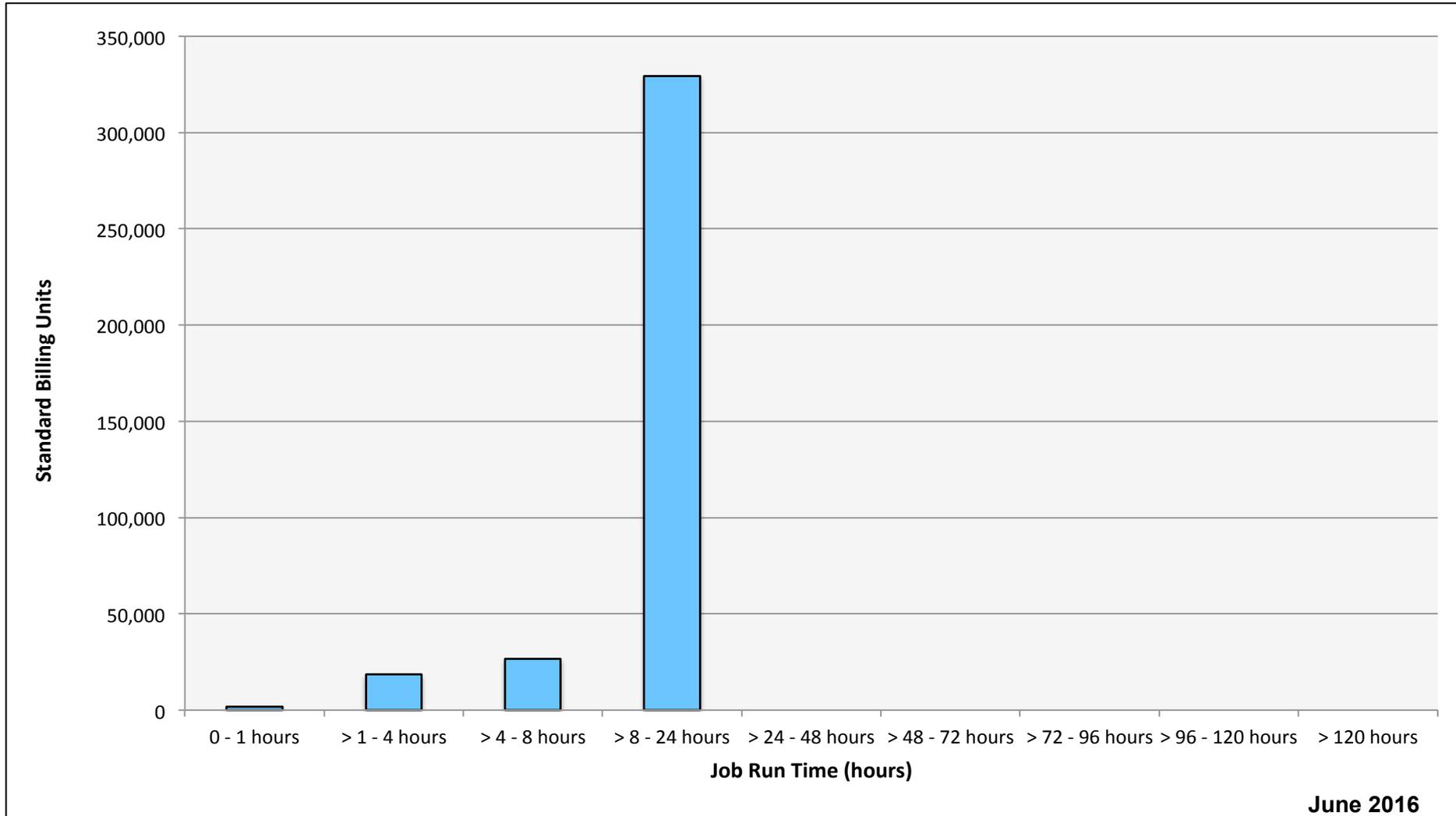
# Endeavour: Average Expansion Factor



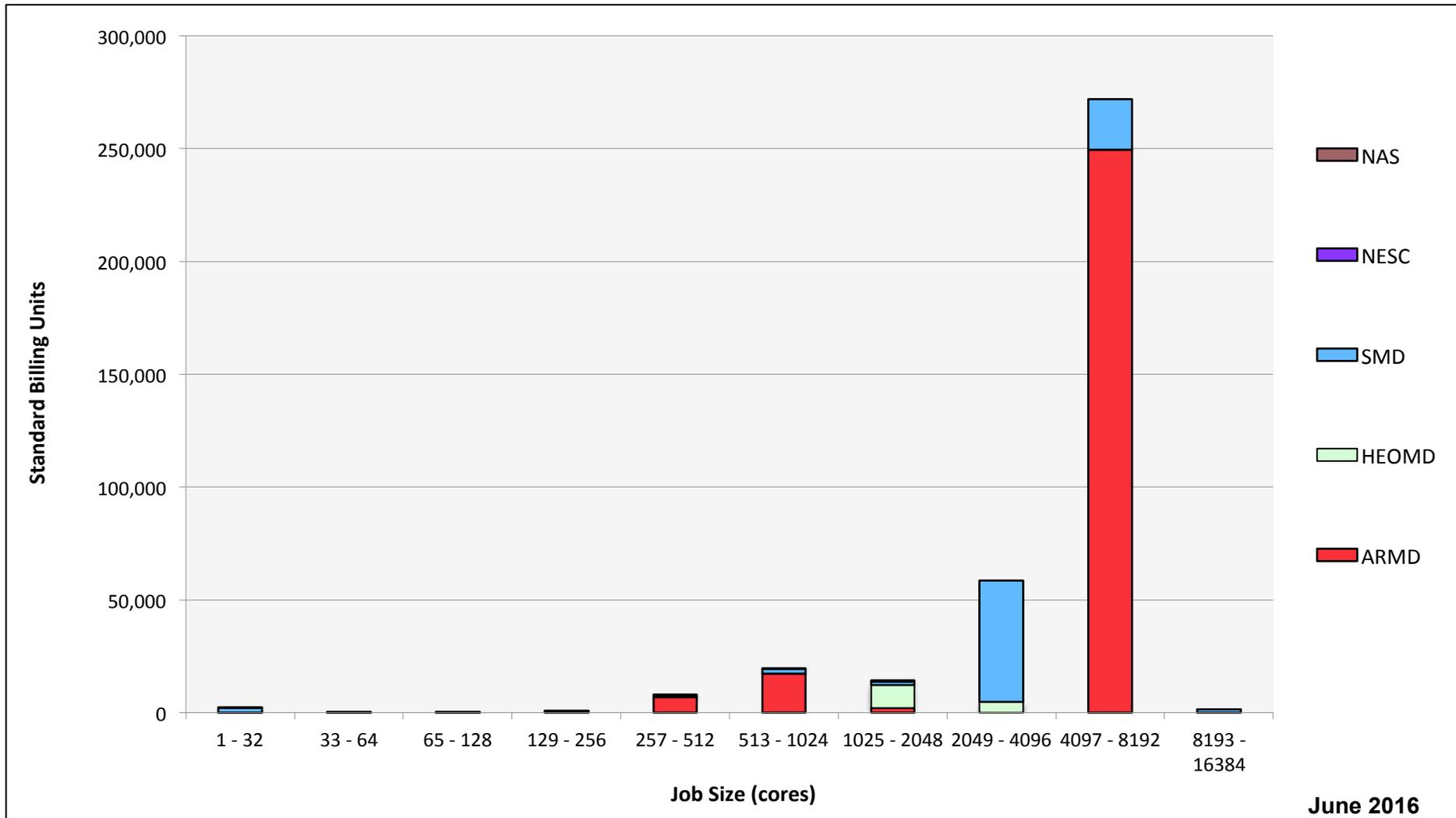
# Merope: SBUs Reported, Normalized to 30-Day Month



# Merope: Monthly Utilization by Job Length

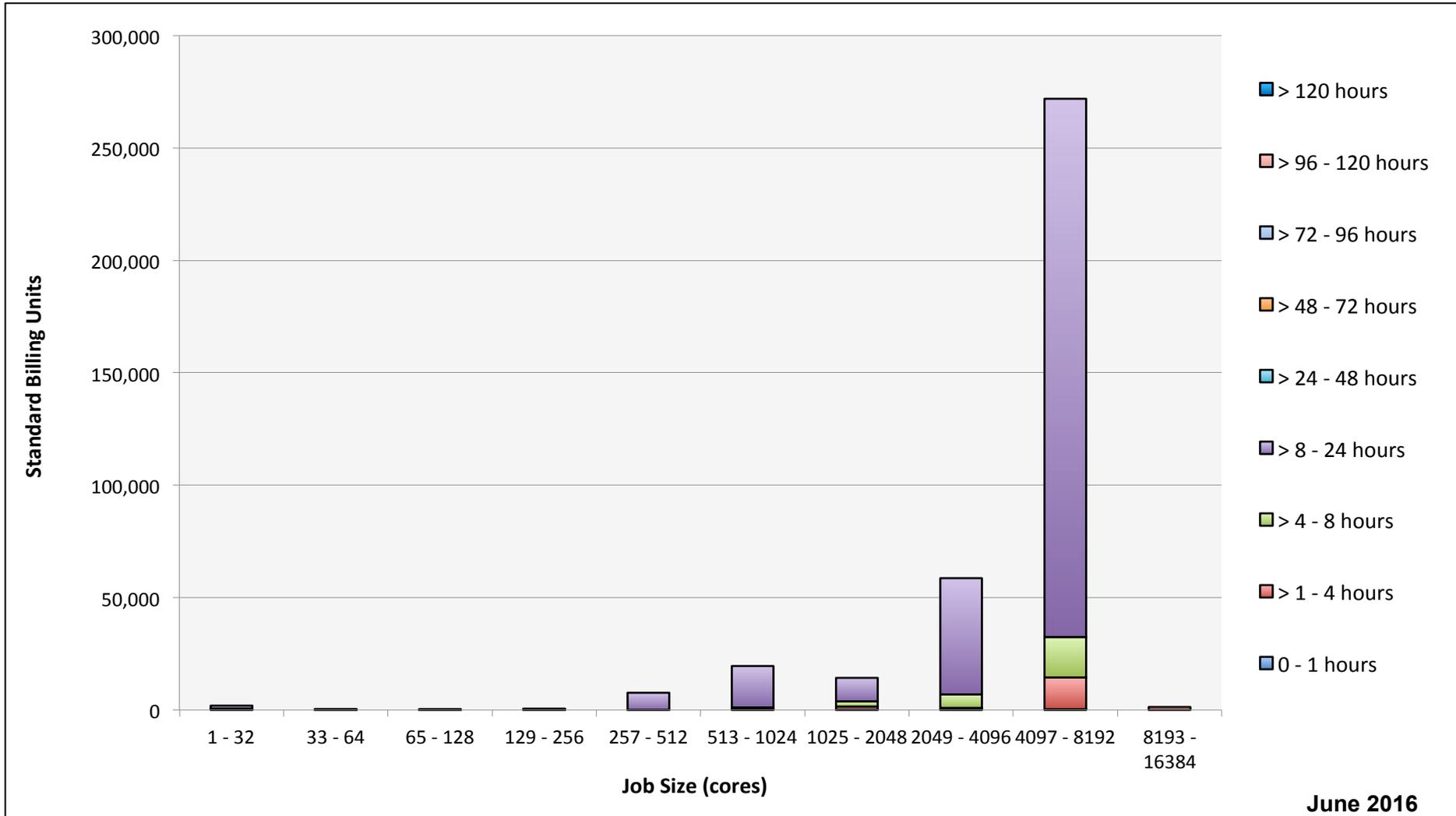


# Merope: Monthly Utilization by Size and Mission



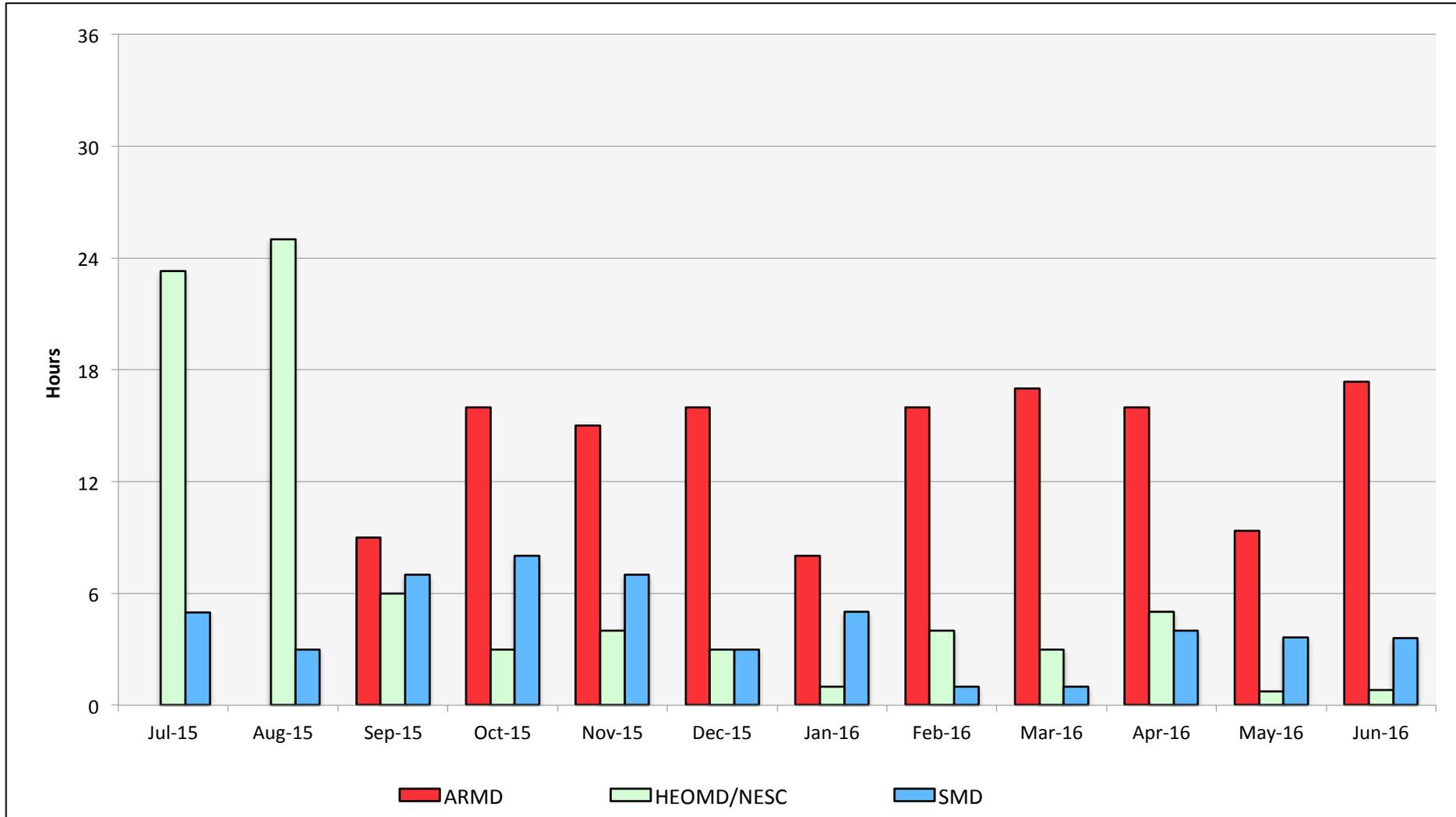
June 2016

# Merope: Monthly Utilization by Size and Length



June 2016

# Merope: Average Time to Clear All Jobs



# Merope: Average Expansion Factor

