Capability Portfolio Status Report

High End Computing Capability

July 10, 2019

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New V100 GPGPU Nodes Get Rave Reviews from Early Users

- The 16 NVIDIA V100 general-purpose graphics processing unit (GPGPU) nodes made available in May received exceptional feedback from early users selected for testing the system.
- Thomas Vandal reported that, compared to one K40 GPU, the V100 nodes are a "gamechanger" for training deep learning models. He obtained a 724% performance improvement from one V100 GPU running the PyTorch deep learning framework on snapshots of the GOES-16 ABI dataset.
- Shuang Li found the V100 nodes "quite impressive" for Earth science applications. His current project needs 520 days to process 250,000 airborne images using one K40 GPU node. However, a single node with four V100 cards can do all the processing in just 14.5 days.
- Fang Hu reported a 13x speed-up running his Time Domain Fast Acoustic Scattering code on one node with eight V100 cards, compared to eight K40 nodes.
- The successful testing and positive feedback from early users prompted deployment of the nodes into general production earlier than the original late June schedule.

Mission Impact: HECC's leading edge general-purpose graphics processing unit (GPGPU) nodes deliver significant performance improvements over the previous technology, which will save time and computational costs for NASA applications across all mission directorates.



HECC's new NVIDIA general-purpose graphics processing unit nodes are housed in three racks on the NASA Advanced Supercomputing facility's main computer floor.

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NAS Facility Expansion's First Module Assembly Nears Completion

- System integration of the NAS Facility Expansion (NFE) First Module has progressed quickly since its installation on May 16, 2019. Work includes:
  - The module's 2.5-megawatt (MW) electrical transformer was installed, which includes the 25-kiloVolt (kV) power conductors from site switchgear, 25-kV – 480-Volt, transformer, and power conductors capable of delivering 3,000 amps throughout the module.
  - The module's two 300-ton adiabatic coolers and two 800-gallon-per-minute pumps are installed and plumbed with 8-inch diameter pipe.
  - The site's 1.1 acre concrete pad is over 90% complete, and will be 100% complete in July.
- The module is on schedule to be fully commissioned by July 25, 2019.
  - Commissioning will include water flow rate verification through the first four Cascade Lake E-Cells, scheduled to arrive on July 19.
- Journalists and officials from NASA, other government organizations, and vendor partners will tour the module during the NFE grand opening on August 22.

Mission Impact: The NAS Facility Expansion infrastructure enables deployment of four times the existing HECC resources to support NASA's future demand for supercomputing resources.



The first module installed at the NAS Facility Expansion site, with adiabatic coolers shown in the background.

POC: Chris Tanner, christopher.tanner@nasa.gov, 650-604-6754, NASA Advanced Supercomputing Division, ASRC

Uninterruptible Power Restored to Main NAS Facility

- On June 29, the rotary uninterruptible power supply (RUPS) was reconfigured to a 3+0 mode (also called the “N configuration”) to provide UPS protection for the main NAS facility, building N258.
  - Protection covers Pleiades, HECC filesystems, the main communications room, the Quantum Artificial Intelligence Laboratory (QuAIL), and the N258 cooling system.
- The facility now has approximately 5.6 megawatts (MW) of load on the UPS with a 6-MW capacity.
- This new configuration improves HECC’s ability to protect running jobs, user data, and networks from future building power failures.
- In the future, when N258 has a power outage, the RUPS will engage, allowing HECC resources to continue operations without interruption.

Mission Impact: Protecting HECC resources at NASA’s largest supercomputing facility provides reduced risk of failure due to power outage events, and increases resource availability for users.



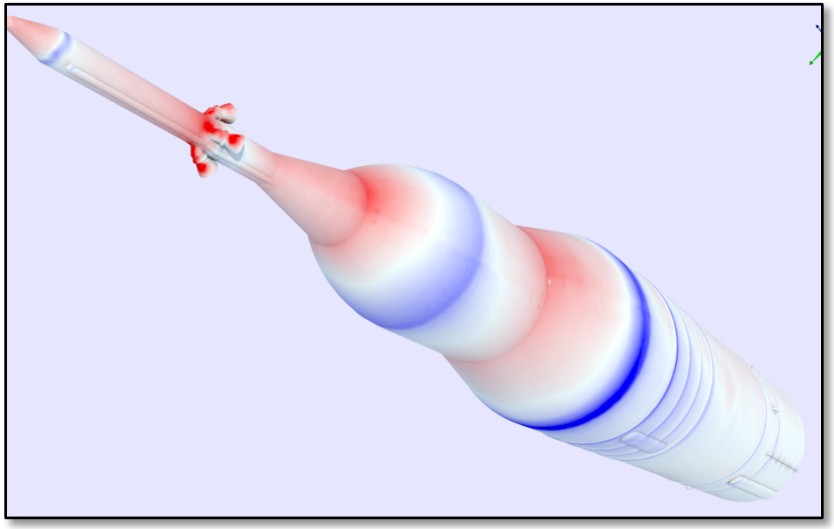
The rotary uninterruptible power supply control panel provides automated decision-making to the electrical distribution system in the event of a power outage at the NASA Advanced Supercomputing facility.

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HECC Visualization Team Achieves 1000-fold Speedup in Processing Wind Tunnel Data

- HECC's Visualization and Data Analysis team recently improved the run time to process wind tunnel data from unsteady pressure-sensitive paint (uPSP) experiments by 1000-fold.
  - The work is part of a collaboration with a wind tunnel group that will send experimental data from Ames' Unitary Plan Wind Tunnel to Bldg. N258 in near-real time.
  - The goal is to provide high-quality results and visuals while the wind-tunnel experiment is in progress, not days or weeks after the fact, as is currently the case.
- The data-processing step is one of many pieces required to achieve this goal. The existing serial code took 14 hours to process a single dataset. HECC engineers reduced the time to 105 seconds—and just 50 seconds when SSDs are used. They used a variety of methods, including:
  - Parallelization with MPI, OpenMP, and custom multi-threading.
  - Use of asynchronous I/O.
  - Improvements to algorithms.
- Other aspects of the collaboration—such as a high-speed network to transmit the data, and tools for visualizing the results—are underway. Visualization and Data Analysis staff are targeting delivering results in September.

Mission Impact: Allowing scientists conducting wind tunnel experiments to analyze data during and make changes during a test will significantly increase the usefulness of the data returned.



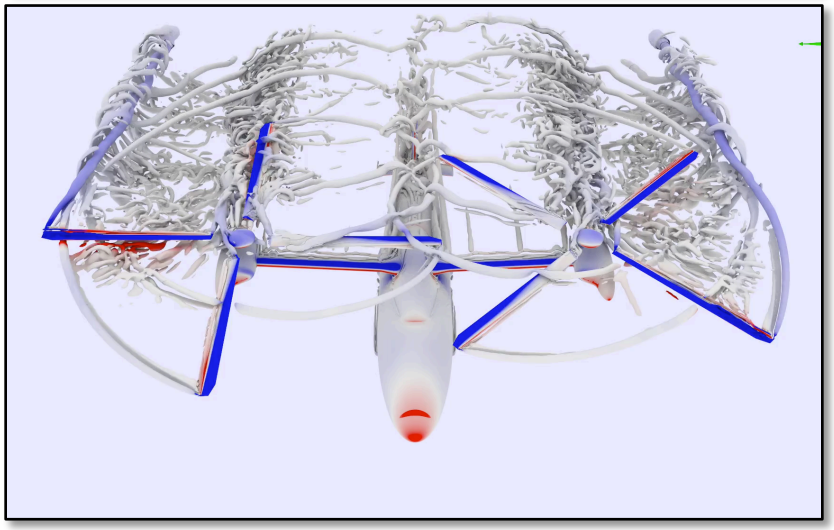
Visualization of unsteady pressure-sensitive paint results, showing local pressure differences on the surface of a Space Launch System model. *Tim Sandstrom, NASA/Ames*

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HECC Urban Air Mobility Visualization Garners First Prize at AIAA Aviation Forum

- A series of HECC-developed visualizations of NASA's side-by-side Urban Air Mobility concept concept won the "Most Artistic Flow Visualization Animation" award at the AIAA Aviation Forum, June 17–21, Dallas, TX.
- Ames researcher Patricia Ventura Diaz presented the Visualization and Data Analysis team's animation to a panel of five judges at the annual AIAA Flow Visualization contest.
  - The visualizations, supporting an Ames study of the aerodynamics and performance of the side-by-side urban air taxi design, helped convey the results: performance of overlapped, side-by-side rotors in cruise is better than that of separate, non-overlapped rotors.
  - Visualization team members created iso-surfaces of a vortex-revealing scalar field, Q-criterion, then colored them to show subtle pressure waves propagating through the wake system.
- The award ceremony will take place at the AIAA Aviation Forum in June 2020 at Reno/Tahoe.

Mission Impact: HECC visualization and data analysis experts work closely with users to create graphics and videos that help gain greater insight into their complex scientific datasets.



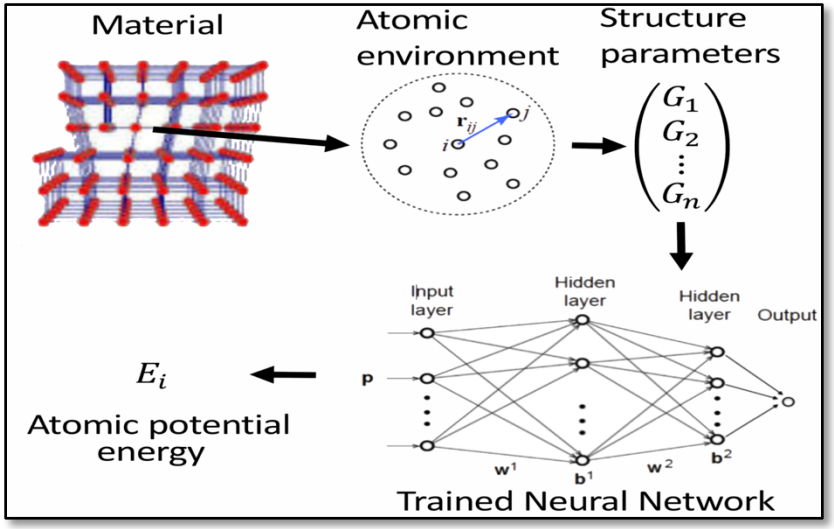
Video from a computational fluid dynamics simulation of an Urban Air Mobility concept vehicle in forward flight. Upper surfaces of the blades are blue (lower pressure), and lower surfaces are red (higher pressure). The combined wake system approximates that of a single wing with a large wing span, which reduces the induced power. Timothy Sandstrom, NASA/Ames

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Collaboration with Material Scientists Improves Performance of a Molecular Dynamics Mini-App

- As part of its educational effort with NASA Langley, HECC's Applications Performance and Productivity (APP) team improved the performance of the Adaptive Neural Network Molecular Dynamics (Aladyn) mini-application by a factor of 4.7 for multi-core CPU computers, and 2.4 for GPU execution.
  - Aladyn, developed at Langley, is an approximation of a full molecular dynamics code, and is designed to demonstrate the use of adaptive neural networks in atomistic simulations.
  - The application is implemented in Fortran 2003. The multi-core compute module uses OpenMP and the GPU compute module uses OpenACC.
- The APP team achieved the CPU speed-up on a Skylake 6154 CPU with 36 threads by:
  - Moving allocate/deallocate statements to an outer level.
  - Using Intel compiler directives to increase the use of avx512 instructions.
  - Changing array layouts to speed memory accesses.
- The GPU speedup was achieved by increasing vectorization and applying array layout changes.
- The APP team is now using Aladyn to explore the tradeoff between performance and effort involved by implementing the GPU kernels in CUDA.

Mission Impact: Educating users on code optimization techniques helps ensure that NASA will be able to meet future computational requirements.



Atomic interactions governed by Quantum Mechanics are very complex and extremely difficult to calculate. The approach of Aladyn and its mini-app is to use a pretrained Neural Network to give the energy of an atom based on its atomic surroundings.

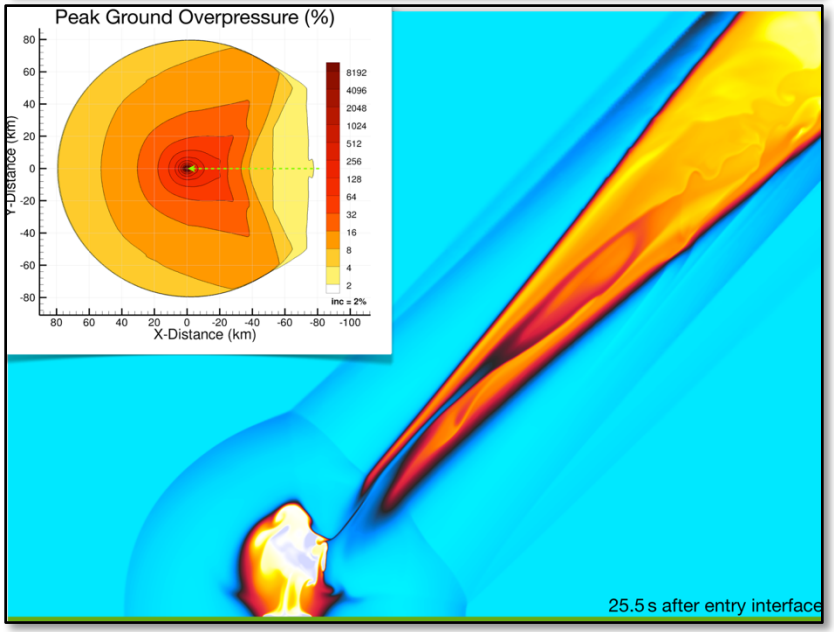
POCs: Gabriele Jost, gabriele.jost@nasa.gov, NASA Advanced Supercomputing (NAS) Division, Supersmith;
Daniel Kokron, daniel.s.kokron@nasa.gov, NAS Division, Redline Performance Solutions

Simulations of Asteroid Impact Scenarios Help NASA Measure Potential Hazards*

- Researchers with NASA's Asteroid Threat Assessment Project (ATAP) are running simulations of hypothetical asteroid impact scenarios on Electra, to better understand potential damage that may be caused by asteroid entry.
- Simulations also include analyses of actual events: Tunguska (1908) and Chelyabinsk (2013).
- The goal is to provide a comprehensive risk modeling and hazard simulation framework, with:
  - Entry, airbursts, and surface impacts.
  - Blast, tsunami, and seismic propagation.
- Parametric studies examined the effects of the angle of entry, and the composition of asteroids on the shape and eccentricity of the ground footprint.
- Simulations of entries over terrain quantified how local topography can amplify the high wind and overpressure, which drive damage estimates.
- Results show:
  - Asteroid-generated tsunamis may pose less risk than previously believed.
  - The average interval between regionally damaging, mid-size asteroid impacts (like the 1908 Tunguska event) is likely to be millennia, rather than centuries.

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

Mission Impact: This simulation-based risk analysis enables the ATAP team to inform the NASA Planetary Defense Coordination Office of potential hazards posed by near-Earth objects.



Simulation of a hypothetical asteroid entry that reaches the ground, showing contours of temperature in the symmetry plane; the inset shows peak overpressures experienced on the ground plane. The asteroid composition is assumed to be normal chondrite with a high internal strength, which is more likely to reach the ground than burst in the air.

POCs: Marian Nemec, marian.nemec@nasa.gov, (650) 604-4319; Michael Aftosmis, michael.aftosmis@nasa.gov, (650) 604-4499, NASA Advanced Supercomputing Division

HECC Facility Hosts Several Visitors and Tours in June 2019

- HECC hosted 12 tour groups in June; guests learned about the agency-wide missions being supported by HECC assets, and also viewed the D-Wave 2000Q quantum system. Visitors this month included:
  - NASA Chief Scientist, Jim Green, along with chief scientists from other centers who were at Ames for the agency's Science Council face-to-face meeting.
  - Victoria Pollard, Bill Crosby, and Thomas Steva, NASA Marshall; and Ross Flach, NASA Ames, who were among a group of engineers and test managers for an upcoming Pressure-Sensitive Paint test at the Unitary Wind Tunnel.
  - A group of Italian solar researchers and members from the Italian Consulate in San Francisco.
  - A large group of chief information officers and chief technical officers from the Department of Homeland Security.
  - A group attending a Procurement face-to-face meeting.
  - A group of students from Finland's leading technical university, Aalto University.
  - Attendees of the Big Data Think Workshop.
  - The 2019 Astronaut Class, who were at Ames for a center-wide tour.
  - Three large groups of NASA Ames summer interns.



Piyush Mehrotra, NASA Advanced Supercomputing (NAS) Division Chief, presents information about the High-End Computing Capability portfolio and the NAS facility to Jim Green, NASA's Chief Scientist.

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

Papers

- "**Use of Polarimetric Radar Measurements to Constrain Simulated Convective Cell Evolution: A Pilot Study with Lagrangian Tracking**," A. Fridlind, et al., Atmospheric Measurement Techniques, vol. 12, issue 6, June 3, 2019. * https://www.atmos-meas-tech.net/12/2979/2019/
- "**Acceleration and Overturning of the Antarctic Slope Current by Wind, Eddies, and Tides**," A. Stewart, Journal of Physical Oceanography, vol. 49, no. 7, June 3, 2019. * https://journals.ametsoc.org/doi/abs/10.1175/JPO-D-18-0221.1
- "**A Regularized Deconvolution Model for Sub-Grid Dispersion in Large Eddy Simulation of Turbulent Spray Flames**," Q. Wang, X. Zhao, M. Ihme, Combustion and Flame, vol. 207, published online June 6, 2019. * https://www.sciencedirect.com/science/article/pii/S0010218019302457
- "**Flutter Boundary Identification from Time-Domain Simulations Using the Matrix Pencil Method**," J. Kiviaho, K. Jacobson, G. Kennedy, AIAA Journal, June 10, 2019. * https://arc.aiaa.org/doi/full/10.2514/1.J058072
- "**A Jacobian-Free Approximate Newton-Krylov Startup Strategy for RANS Simulations**," A. Yildirim, et al., Journal of Computational Physics, June 12 2019. * https://www.sciencedirect.com/science/article/pii/S0021999119304255
- "**Quantifying Gravity Wave Forcing Using Scale Invariance**," H.-L. Liu, Nature Communications, published online June 13, 2019. * https://www.nature.com/articles/s41467-019-10527-z

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

Papers (cont.)



- **AIAA Aviation Forum**, Dallas, TX, June 17-21, 2019.
  - "**Performance Enhancement of the Flexible Transonic Truss-Braced Wing Aircraft Using Variable-Camber Continuous Trailing-Edge Flaps**," R. Bartels, B. Stanford, J. Waite. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3160
  - "**Development of Unsteady Pressure-Sensitive Paint Application on NASA Space Launch System**," N. Roozeboom, et al. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3502
  - "**High Ice Water Content in Tropical Cyclones During NASA/FAA Radar Flight Campaigns with Comparison to Numerical Simulations**," F. Proctor, S. Harrah, G. Switzer, et al. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3304
  - "**Nonlinear Görtler Vortices and Their Second Instability in a Hypersonic Boundary Layer**," F. Li, M. Choudhari, P. Paredes. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3216
  - "**Laminar-Turbulent Transition Upstream of the Entropy-Layer Swallowing Location in Hypersonic Boundary Layers**," P. Paredes, M. Choudhari, F. Li. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3215
  - "**Kestrel Results at Liftoff Conditions for a Space Launch System Configuration in Proximity to the Launch Tower**," S. Krist, N.Ratnayake, F. Ghaffari. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3400
  - "**Space Launch System Booster Separation Supersonic Powered Testing with Surface and Off-Body Measurements**," C. Winski, et al. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3505
  - "**Aeropropulsive Design Optimization of a Boundary Layer Ingestion System**," A. Yildirim, et al. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3455

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Papers (cont.)

- **AIAA Aviation Forum** (cont.)
  - "**Computational Fluid Dynamics Methods Used in the Development of the Space Launch System Liftoff and Transition Lineloads Databases**," N.Ratnayake, et al. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3399
  - "**Additional Findings from the Common Research Model Natural Laminar Flow Wind Tunnel Test**," M. Lynde, R. Campbell, S. Viken. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3292
  - "**Aeroelastic Indicial Response Reduced-Order Modeling for Flexible Flight Vehicles**," B. Hiller, N. Frink, W. Silva. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3388
  - "**Towards a Validated FSI Computational Framework for Supersonic Parachute Deployments**," J. Rabinovitch, et al. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3275
  - "**Hypervelocity Noble Gas Sampling in the Upper Atmosphere of Venus**," J. Rabinovitch, et al. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3223
  - "**Comparative Study of Active Flow Control Strategies for Lift Enhancement of a Simplified High-Lift Configuration**," V. Vatsa, et al. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3724
  - "**Assessment of Mixer-Ejector Nozzle with Thermal Acoustic Shield for Jet Noise Reduction**," J. Burt, J. Seidel, S. Leib. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3018

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Papers (cont.)

- "**Buoyancy-Driven Entrainment in Dry Thermals**," B. McKim, N. Jeevanjee, D. Lecoanet, arXiv:1906.07224 [physics.flu-dyn], June 17, 2019. * https://arxiv.org/abs/1906.07224
- "**Turbulence and Particle Acceleration in Collisionless Magnetic Reconnection: Effects of Temperature Inhomogeneity Across Pre-Reconnection Current Sheet**," S. Lu, et al., The Astrophysical Journal, vol. 878, no. 2, June 19, 2019. * https://iopscience.iop.org/article/10.3847/1538-4357/ab1f6b/meta
- "**A Minimum Entropy Principle in the Compressible Multicomponent Euler Equations**," A. Gouasmi, et al., arXiv:1906.08845 [math.AP], June 20, 2019. * https://arxiv.org/abs/1906.08845
- "**A Super-Earth and Sub-Neptune Transiting the Late-Type M Dwarf LP 791-18**," I. Crossfield, et al., arXiv:1906.09267 [astro-ph.EP], June 21, 2019. * https://arxiv.org/abs/1906.09267
- "**Rapid Particle Acceleration Due to Re-Collimation in Injected Jets with Helical Magnetic Fields**," K. Nishikawa, et al., arXiv:1906.10302 [astro-ph.HE], June 25, 2019. * https://arxiv.org/abs/1906.10302

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Presentations

- **AIAA Aviation Forum**, Dallas, TX, June 17-21, 2019.
  - "**Preliminary Scale-Resolving Simulations of Laminar-to-Turbulent Transition in Swept-Wing Flow**," M. Denison, A. Garai, S. Murman. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3534
  - "**A New Recycling Method to Generate Turbulent Inflow Profiles**," A. Garai, S. Murman, D. Ekelschot. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3420
  - "**Extending a Correction Method for Unsteady Transonic Aerodynamics to Variable Camber Continuous Trailing Edge Flap**," U. Kaul, N. Nguyen. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3157
  - "**Simulation of HyMETS Flowfield Around Baby-SPRITE Entry Probe**," P. Ventura Diaz, S. Yoon, F. Panerai, N. Mansour. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3262
  - "**Fully-Coupled Fluid-Structure Interaction Simulations of a Supersonic Parachute**," J. Boustani, M. Barad, C. Kiris, C. Brehm. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3279
  - "**Simulations of Ducted and Coaxial Rotors for Air Taxi Operations**," P. Ventura Diaz, R. Caracuel Rubio, S. Yoon. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-2825
  - "**Efficient Near-Field to Mid-Field Sonic Boom Propagation using a High-Order Space Marching Method**," J. Housman, G. Kenway, J. Jensen, C. Kiris. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3487
  - "**Adjoint-Based Mesh Adaptation and Shape Optimization for Simulations with Propulsion**," M. Nemec, D. Rodriguez, M. Aftosmis. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3488

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Presentations (cont.)

- **AIAA Aviation Forum** (cont.)
  - "**Comparison Between Traditional and Competitive Reaction Models for the Pyrolysis of High Temperature Aerospace Materials**," F. Torres Herrador, J. Coheur, T. Magin, J. Blondeau, J. Meurisse, F. Panerai, J. Lachaud, N. Mansour. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3361
  - "**The Side-by-Side Urban Air Taxi Concept**," P. Ventura Diaz, W. Johnson, J. Ahmad, S. Yoon. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-2828
  - "**On Unsteadiness of Ship Airwakes Subject to Atmospheric Boundary-Layer Inflow from a Helicopter Operation Perspective**," R. Thedin, S. Murman, J. Horn, S. Schmitz. * https://arc.aiaa.org/doi/pdf/10.2514/6.2019-3032
- "**Scale-Resolving Simulations of a Fundamental Trailing-Edge Cooling Slot Using a Discontinuous-Galerkin Spectral-Element Method**," A. Garai, S. Murman, N. Madavan, presented at the ASME Turbomachinery Technical Conference & Exposition, Phoenix, AZ, June 17–21, 2019. * https://ntrs.nasa.gov/search.jsp?R=20190026508
- "**HPC Matters! How Supercomputing Impacts NASA's Mission**," P. Mehrotra, presented at the 2019 Ames Summer Series, NASA Ames Research Center, Moffett Field, CA, June 26, 2019.

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News and Events



- **Preparing Scientific Applications for Exascale Computing**, *Phys.org Feature Story,* June 11, 2019—Computer scientists from the NASA Advanced Supercomputing Division participated in a hackathon that included NASA, the Department of Energy, and supercomputing leaders in academia and industry, with the goal to port scientific applications from traditional CPUs to graphics processing units using the latest version of OpenMP. https://phys.org/news/2019-06-scientific-applications-exascale.html
- **Solar Activity Forecast for Next Decade Favorable for Exploration**, *NASA Ames Release*, June 12, 2019—New research led by user Irina Kitiashvili, Bay Area Environmental Research Institute, may be more reliable than other methods to predict the Sun's activity, and its forecast for a less active decade ahead is good news for exploration. Kitiashvili used the Pleiades and Electra supercomputers for her space weather predicton simulations. https://www.nasa.gov/feature/ames/solar-activity-forecast-for-next-decade-favorable-for-exploration
- **Simulations Give NASA Code Green Light for Space Launch System Testing**, *NAS Feature Story*, June 12, 2019—Proof-of-concept tests of NASA's Loci/CHEM flow solver on the Pleiades supercomputer validate the solver's accuracy, clearing the way for tests for the agency's next-gen Space Launch System's launch environment. https://www.nas.nasa.gov/publications/articles/feature_LociCHEM_launch_sound_suppression.html

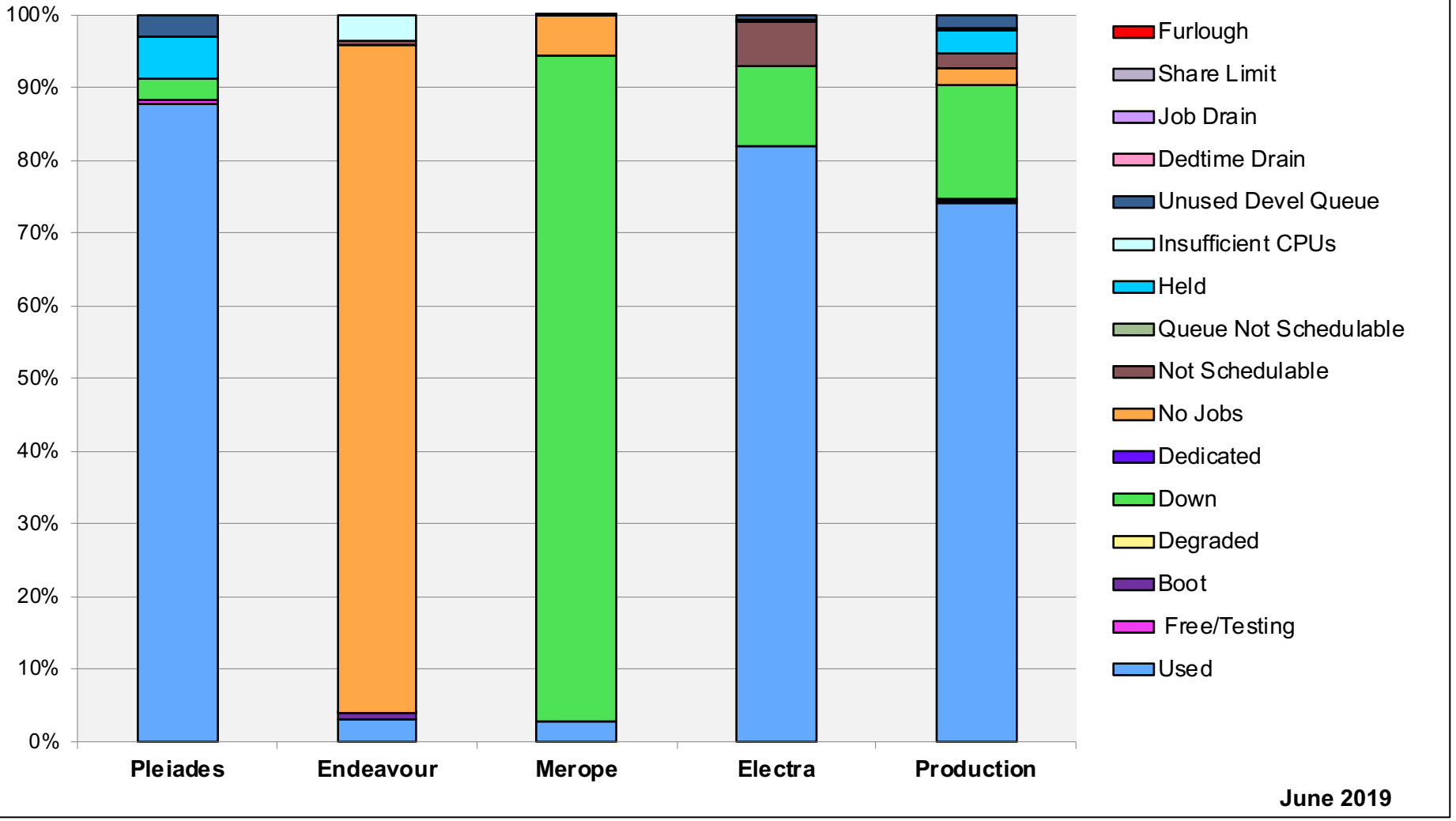
News and Events (cont.)

- **Study Predicts More Long-Term Sea Level Rise from Greenland Ice**, *NASA Goddard Feature Story*, June 19, 2019—Greenland's melting ice sheet could generate more sea level rise than previously thought if greenhouse gas emissions continue to increase and warm the atmosphere at their current rate, according to a new modeling study run on supercomputers at NAS and the University of Alaska Fairbanks.
  https://www.nasa.gov/feature/goddard/2019/study-predicts-more-long-term-sea-level-rise-from-greenland-ice
- **Supercomputers–Saving the World One Asteroid at a Time**, *The Verdict*, June 28, 2019—As part of the National Science & Technology Council's Near-Earth Object Preparedness Strategy and Action Plan, researchers are using the Pleiades supercomputer to run high-fidelity simulations of potential asteroid impacts.
  https://www.verdict.co.uk/asteroid-day-supercomputers/
  - **Asteroids, SUSE and Protecting the Planet**, *SUSE Blog*, June 24, 2019.
    https://www.suse.com/c/asteroids-suse-and-protecting-the-planet/

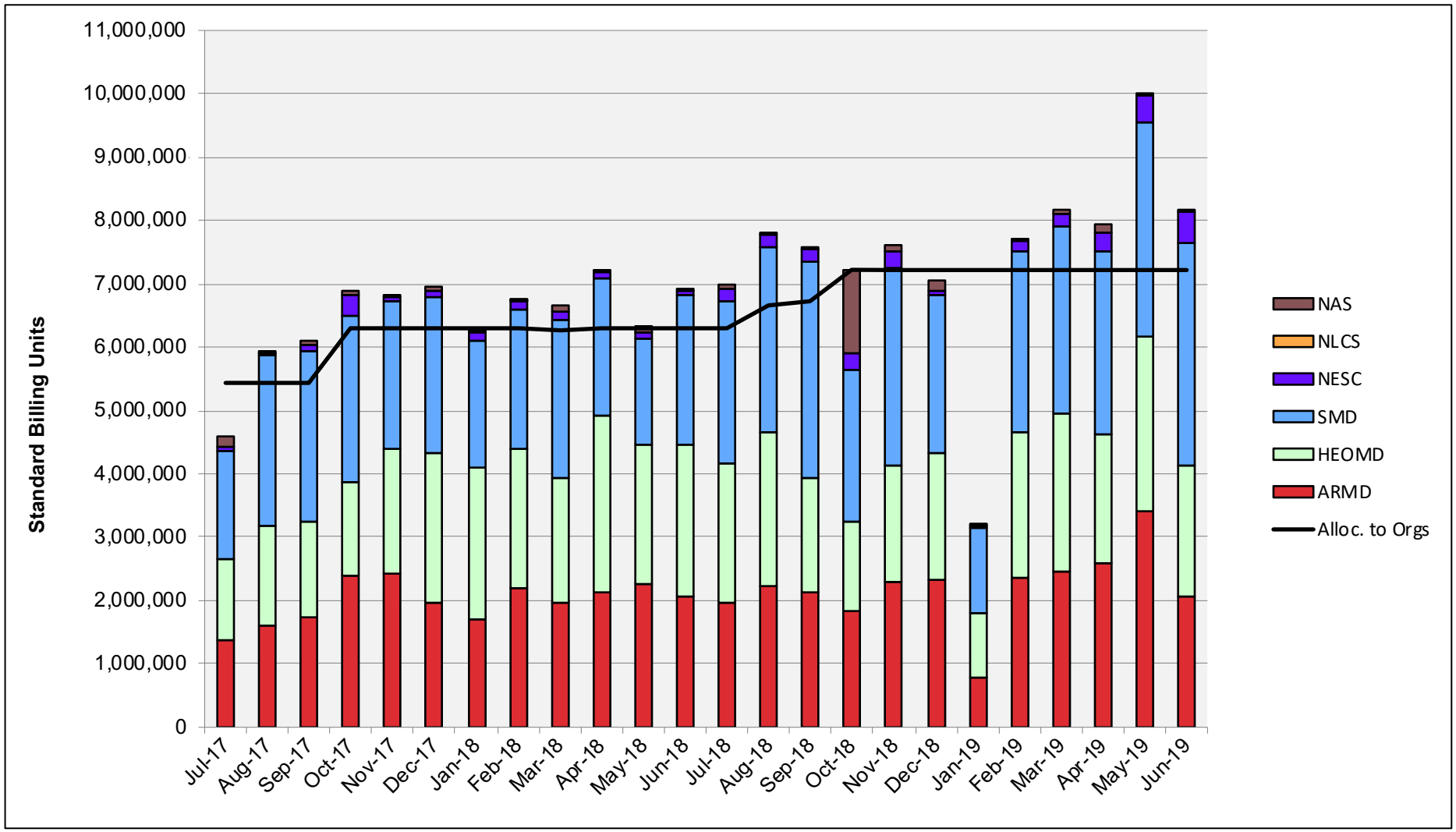
News and Events: Social Media

- **Top Posts from NAS**
  - Loci/CHEM Launch Sound Suppression Feature Story:
    - Twitter: 2 retweets, 5 likes
    - Twitter: 8 retweets, 32 likes
    - Facebook: 426 users reached, 48 engagements
  - Solar Simulations Predict Decade of Good Space Weather:
    - Twitter: 1 retweet, 2 likes
    - Twitter: 1 retweet, 5 likes
    - Facebook: 243 users reached, 12 engagements

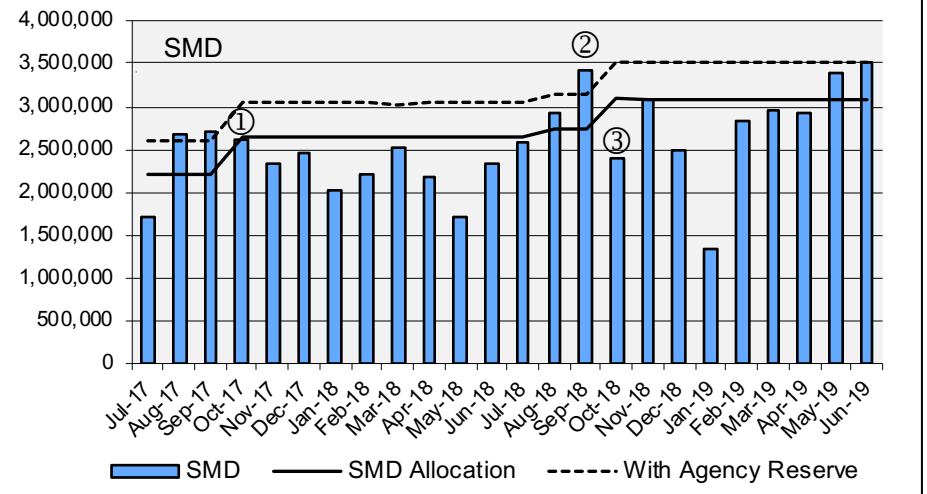
HECC Utilization

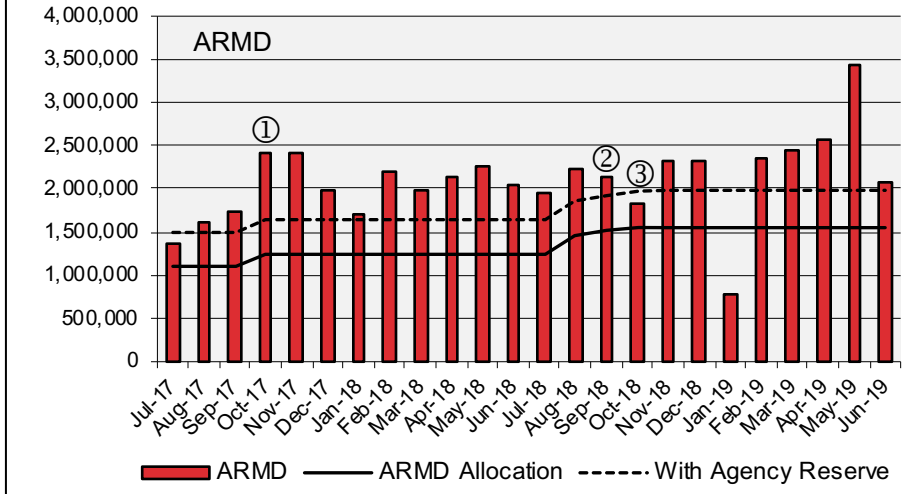


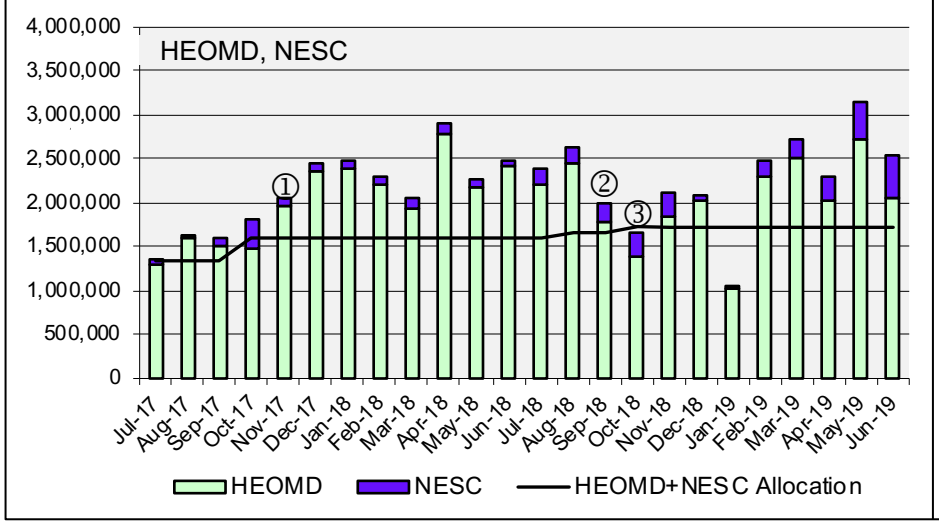
HECC Utilization Normalized to 30-Day Month



HECC Utilization Normalized to 30-Day Month





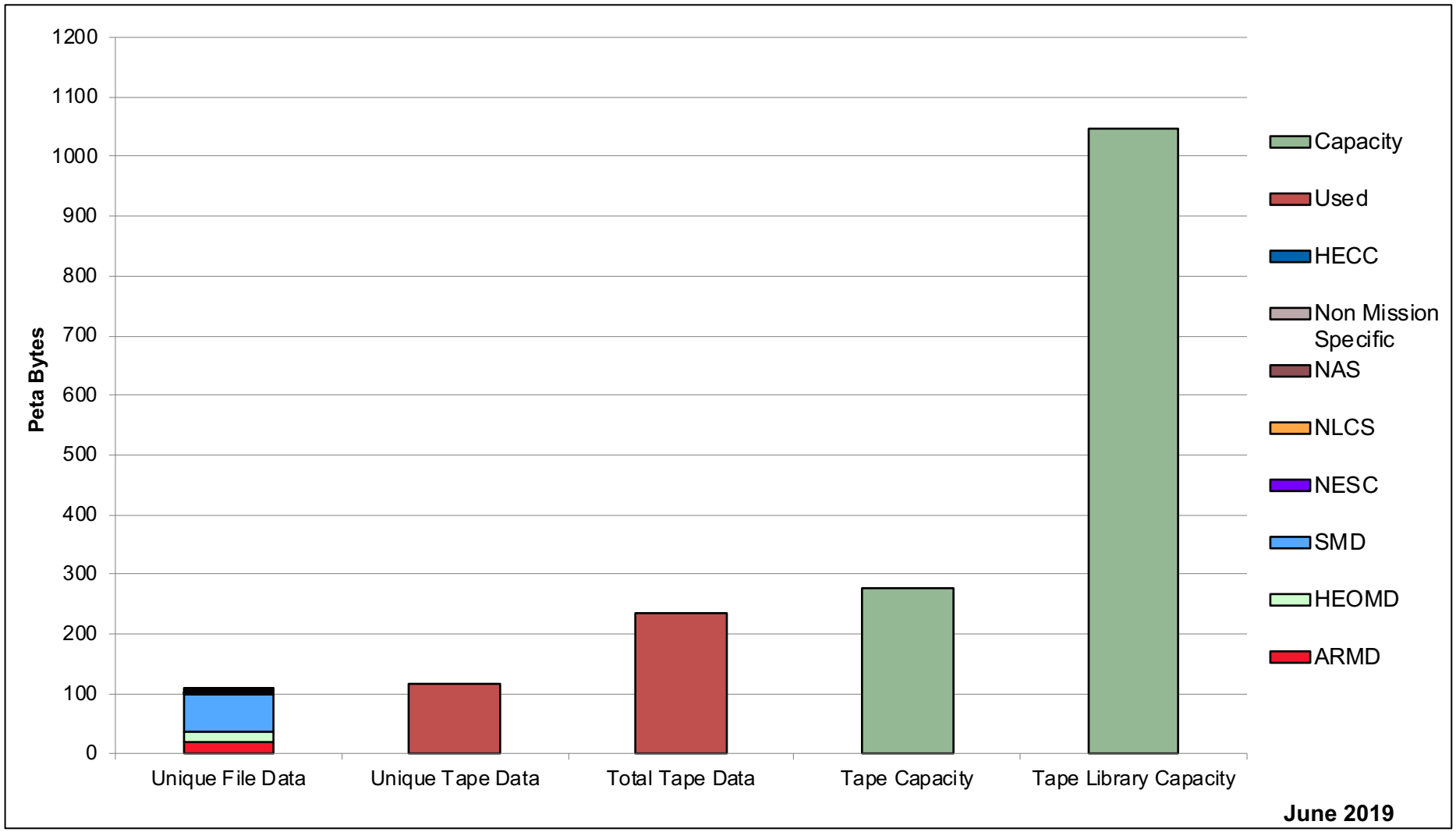


① 4 Skylake E cells (16 D Rack Equivalence) added to Electra

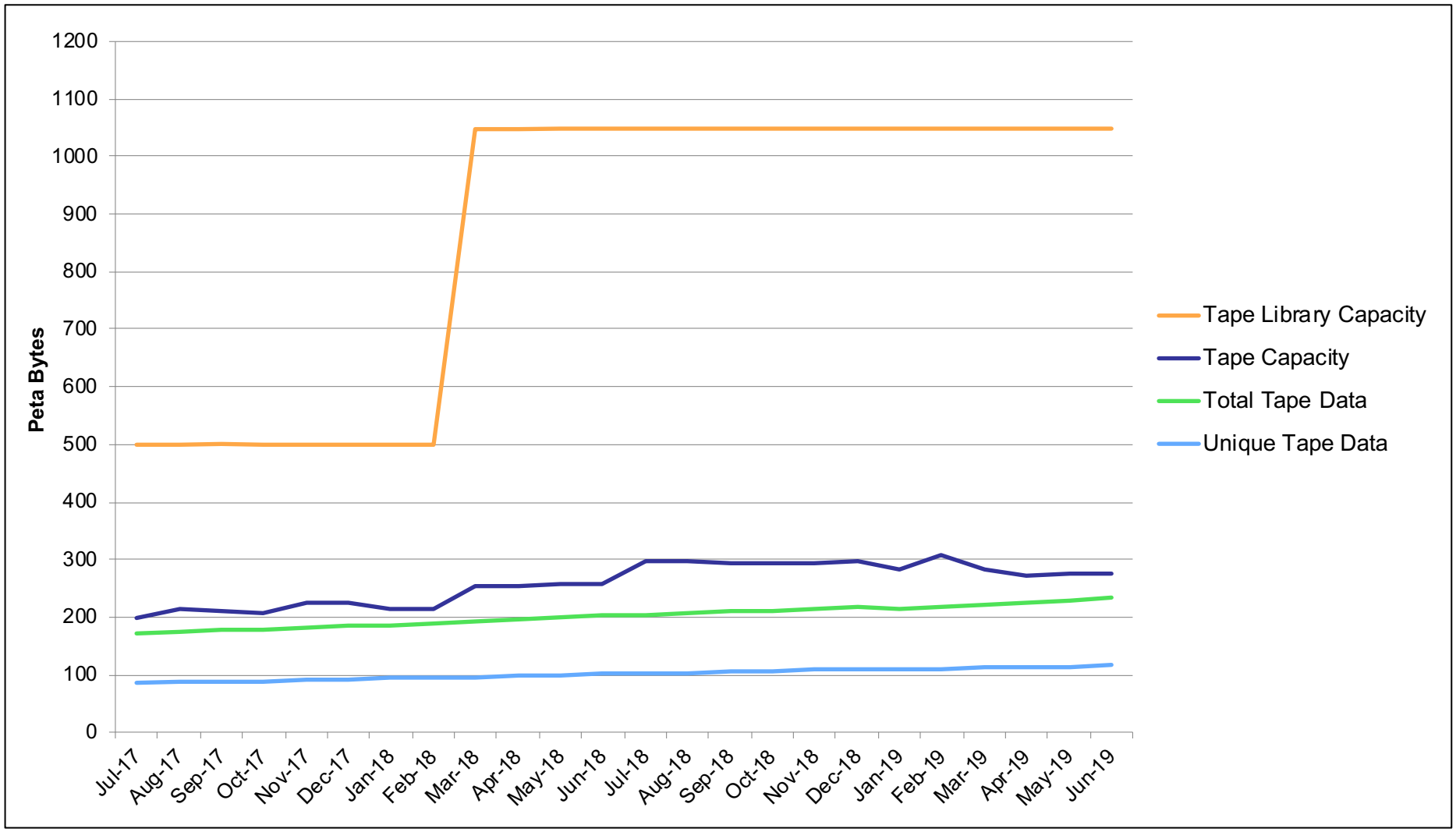
② 2 Skylake E cells (8 D Rack Equivalence) added to Electra; 1 rack is dedicated to ARMD

③ 2 Skylake E cells (8 D Rack Equivalence) added to Electra; 1 rack is dedicated to SMD

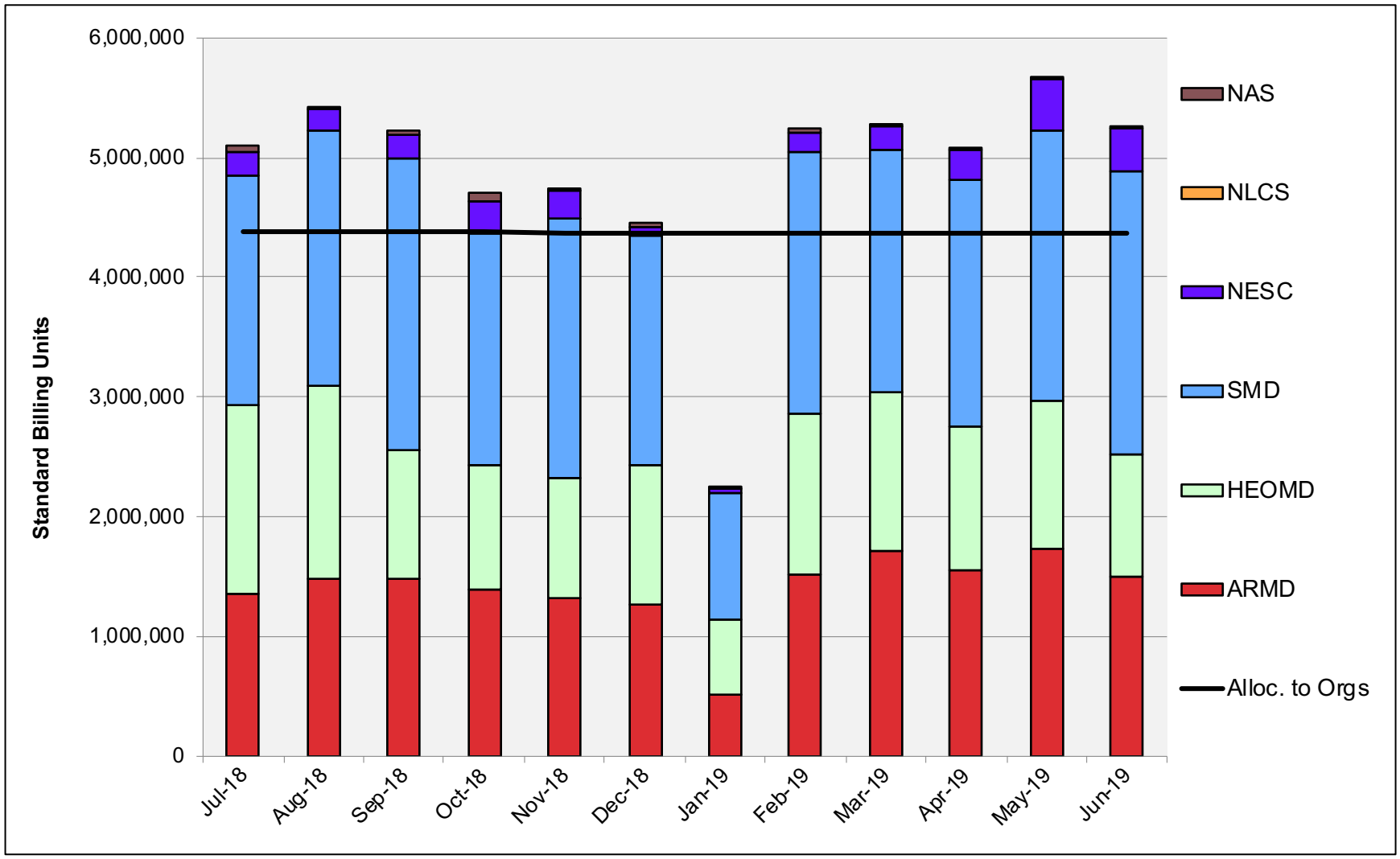
Tape Archive Status



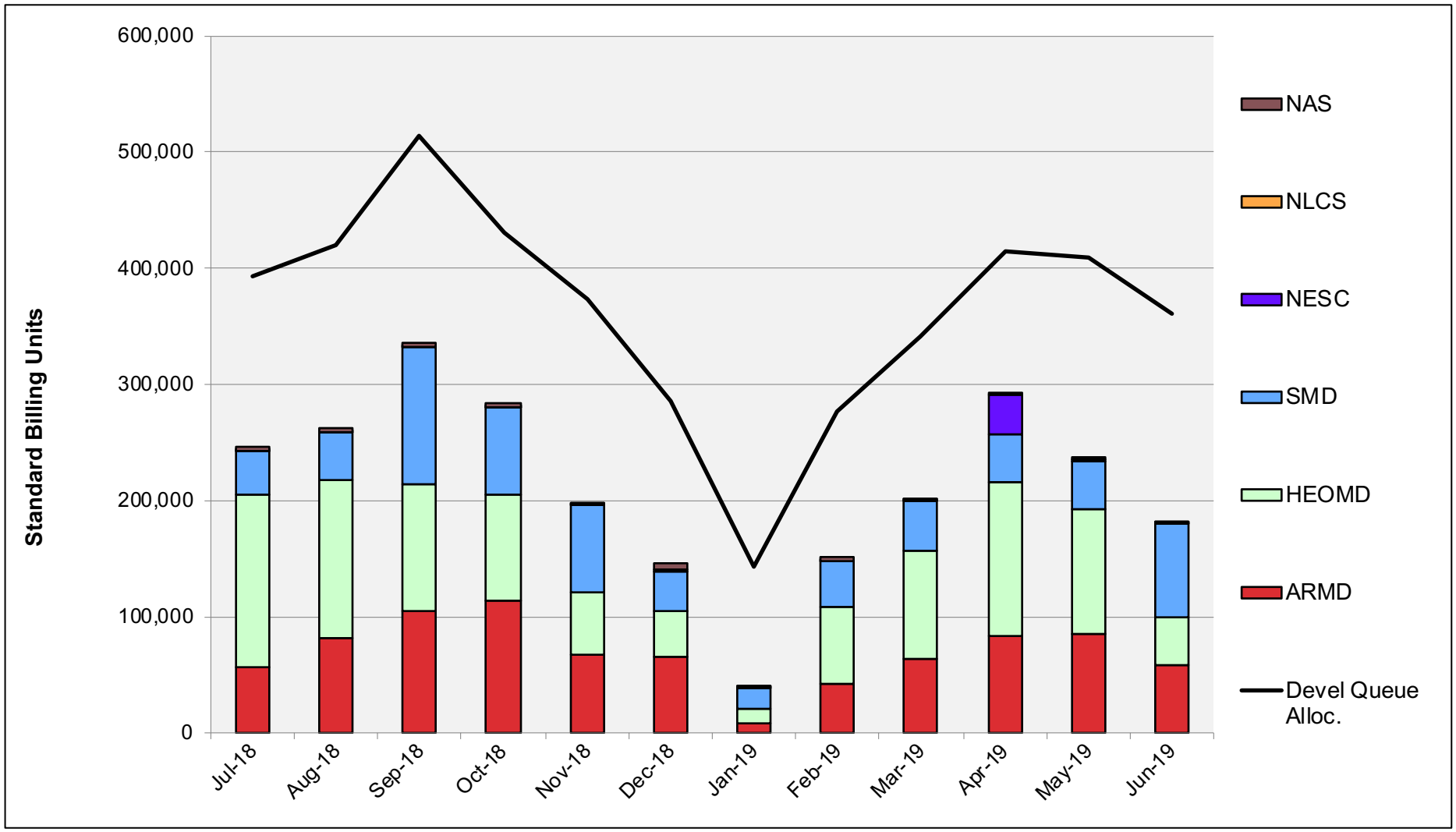
Tape Archive Status



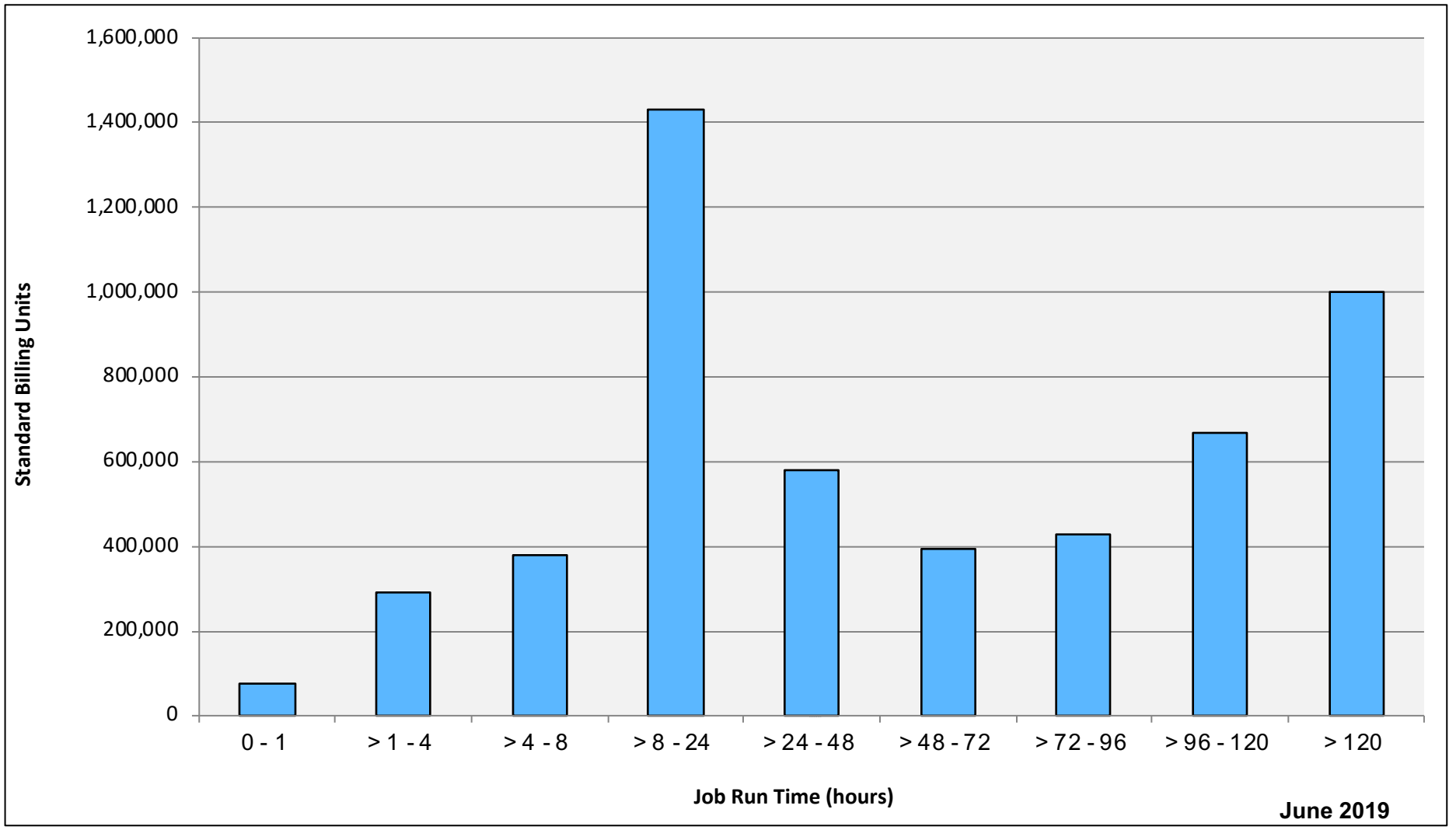
Pleiades:
SBUs Reported, Normalized to 30-Day Month



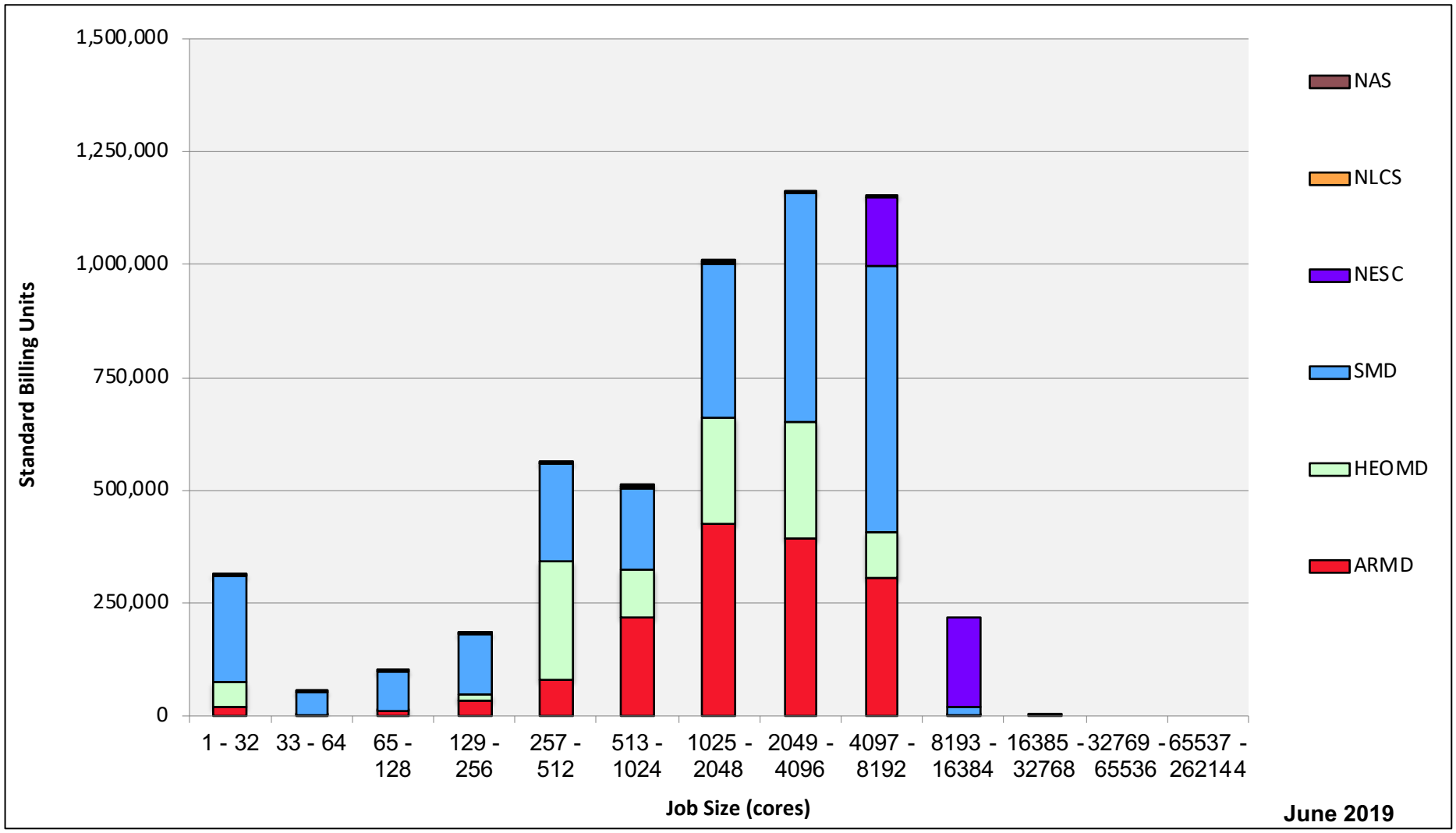
Pleiades:
Devel Queue Utilization



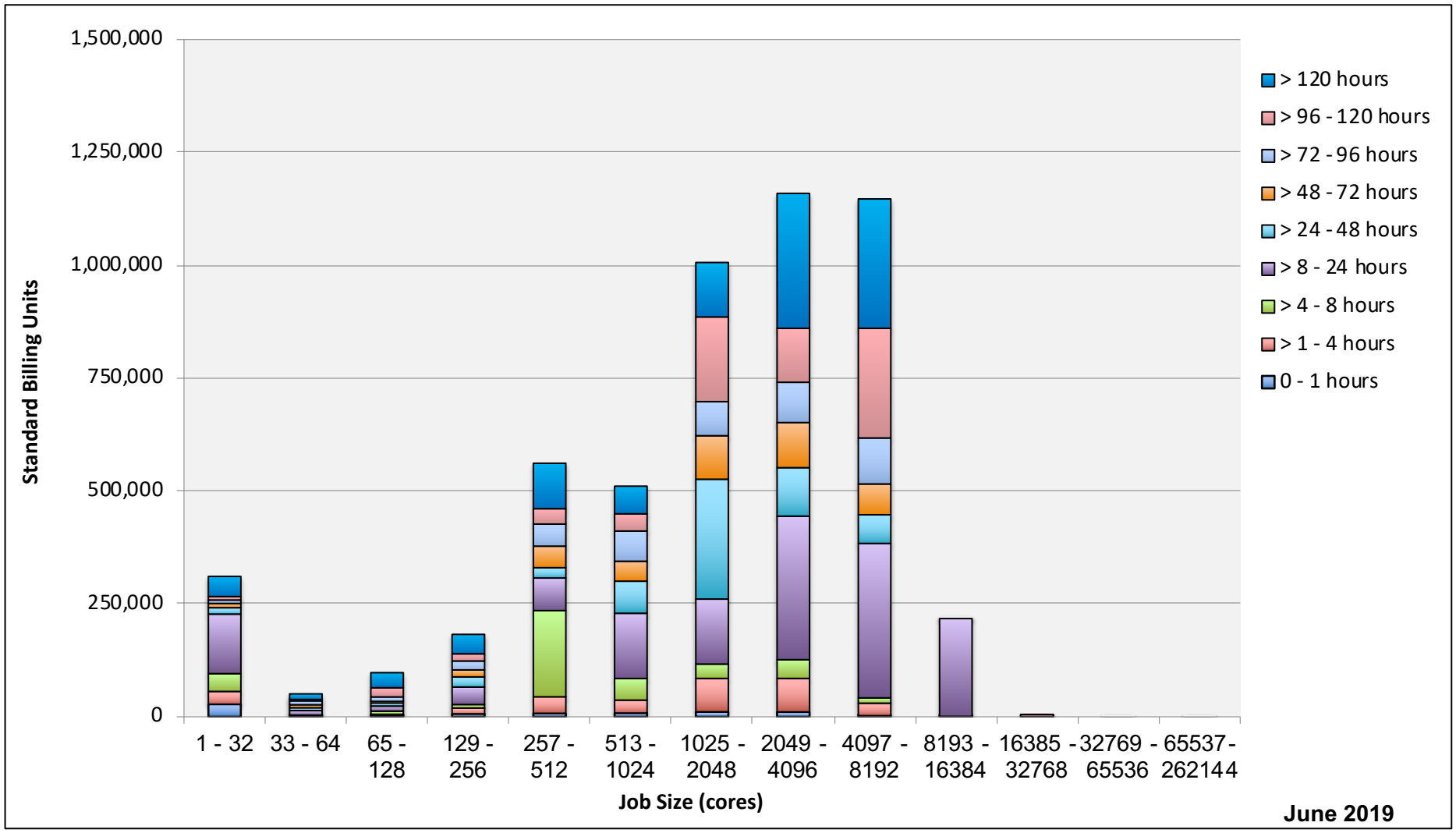
Pleiades:
Monthly Utilization by Job Length



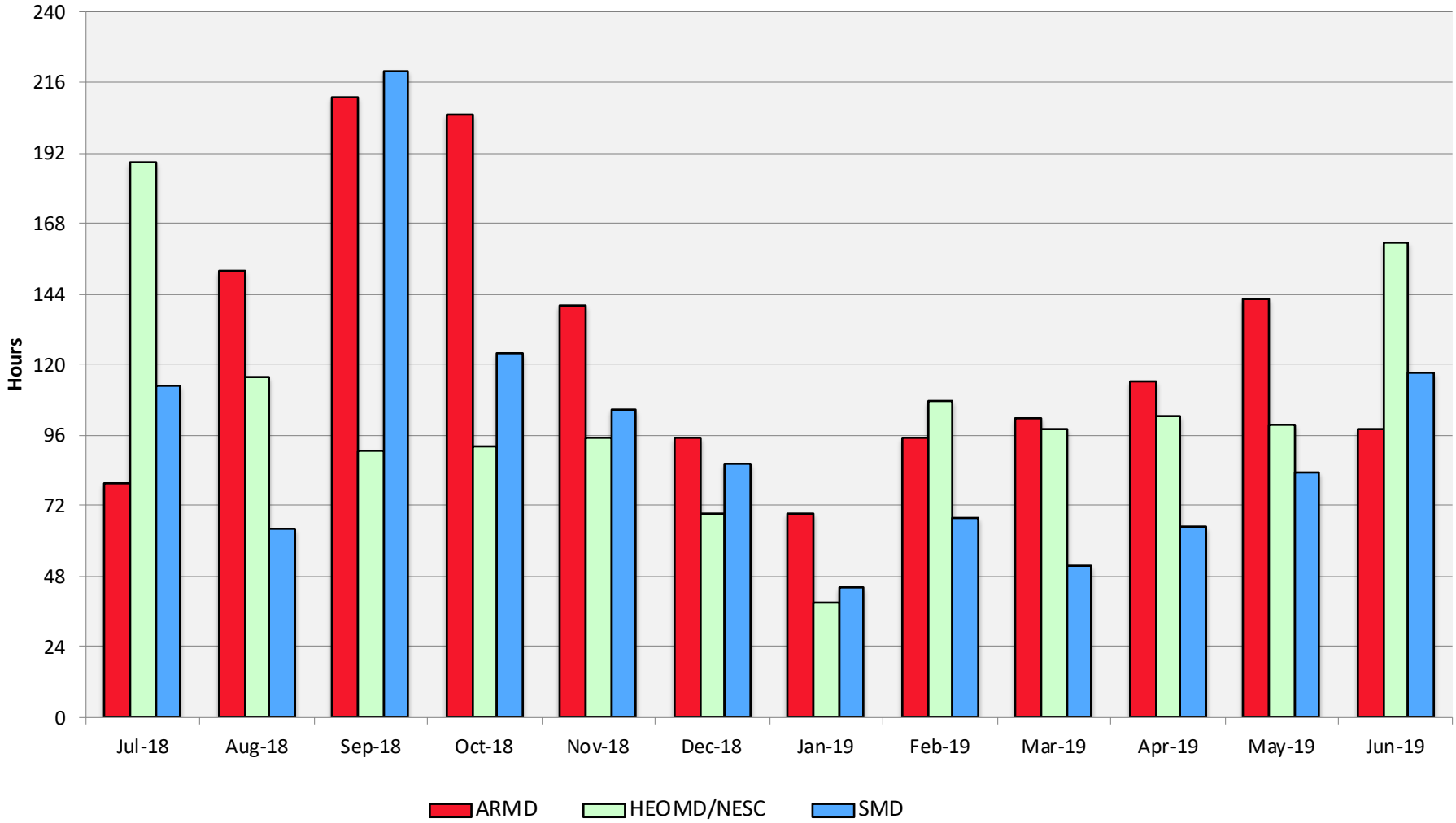
Pleiades:
Monthly Utilization by Size and Mission



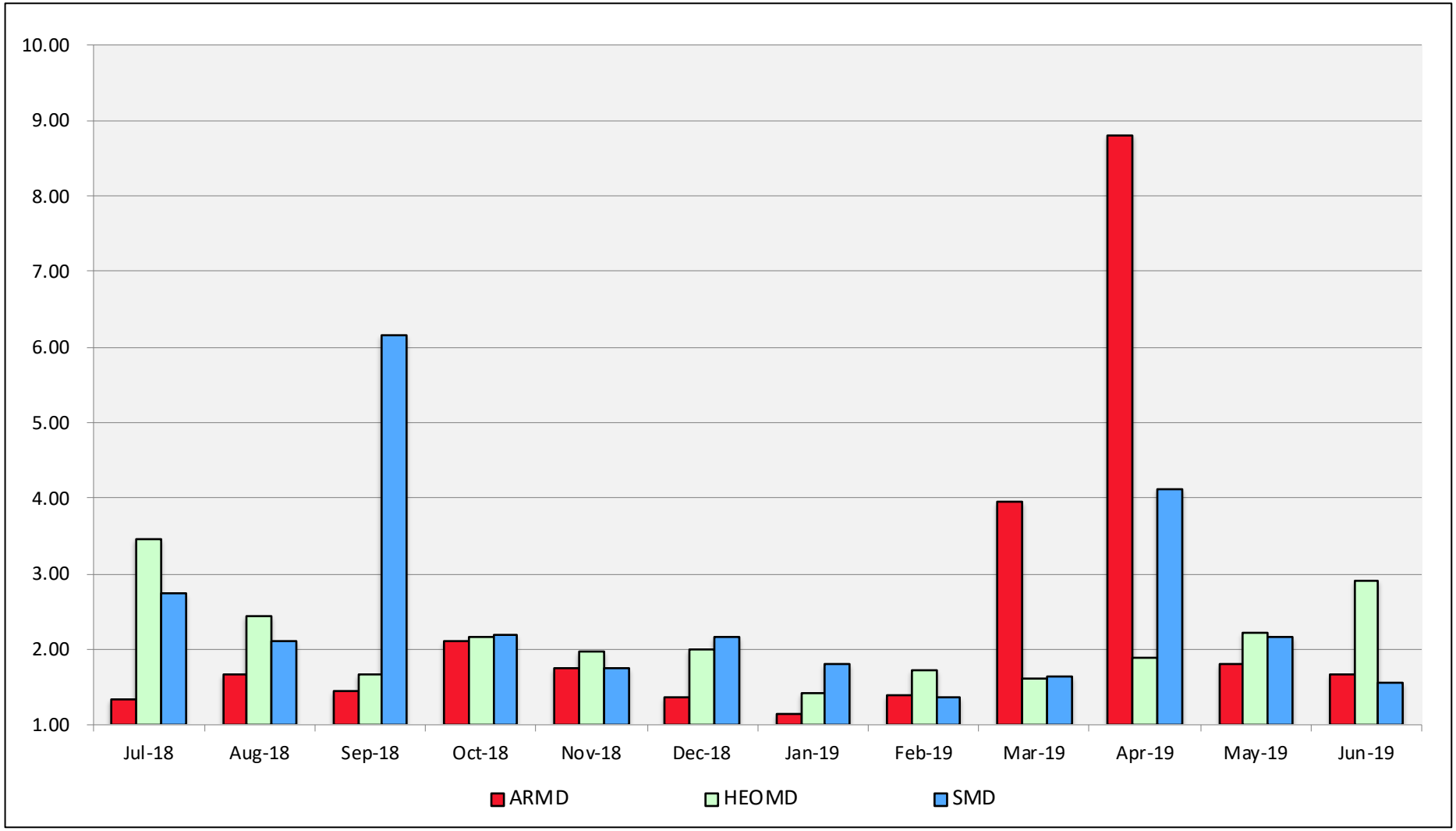
Pleiades:
Monthly Utilization by Size and Length



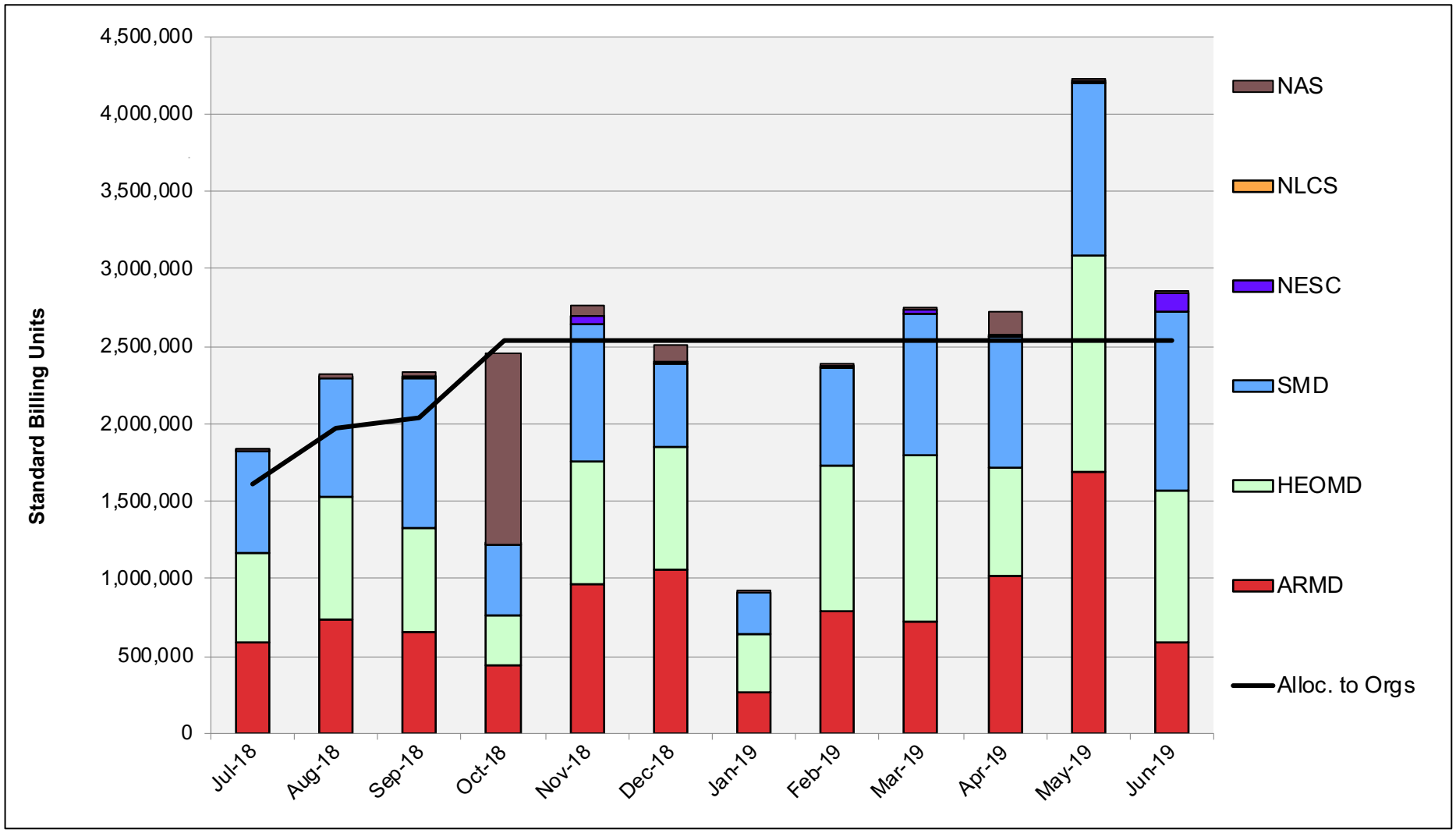
Pleiades:
Average Time to Clear All Jobs



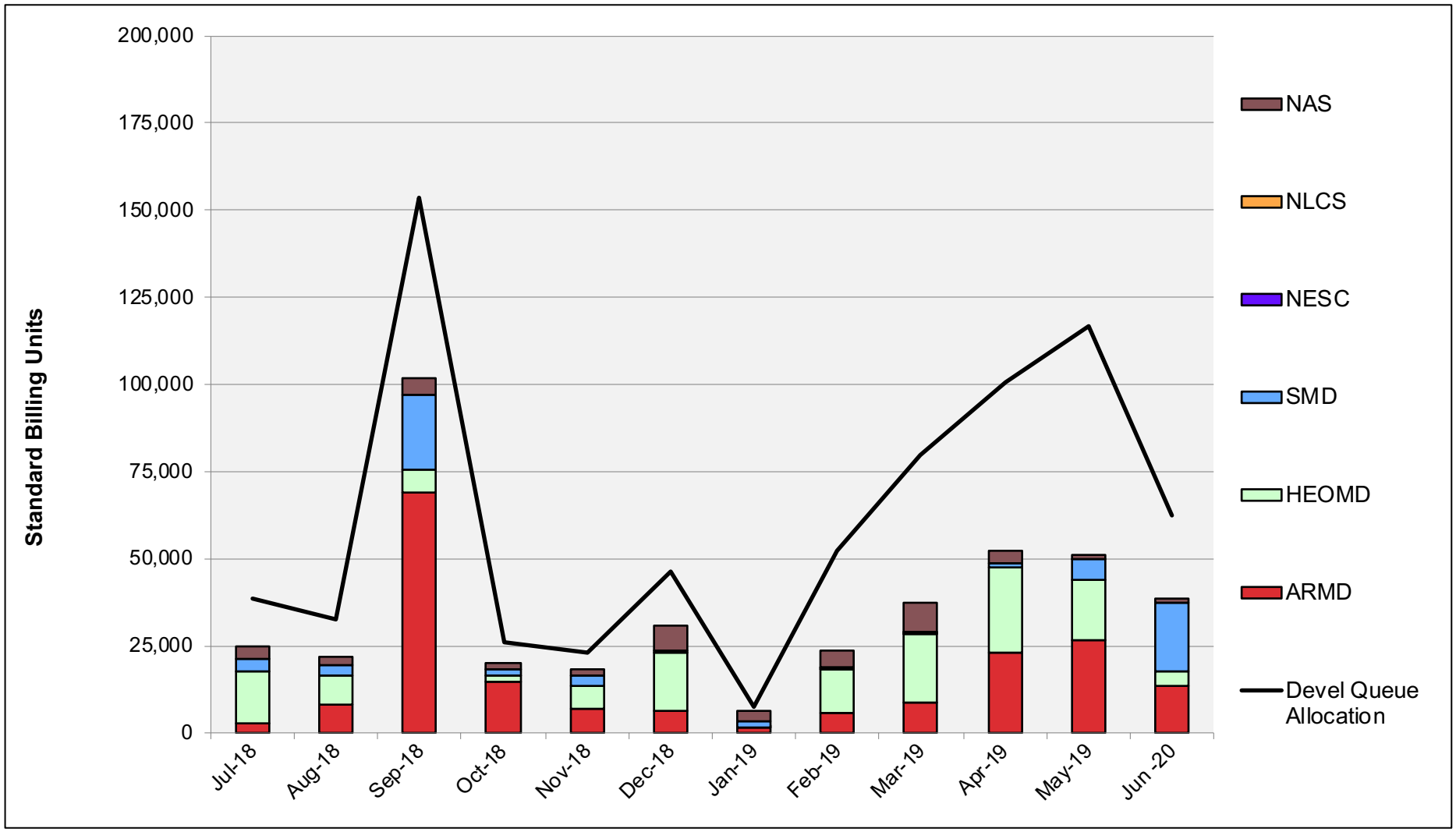
Pleiades:
Average Expansion Factor



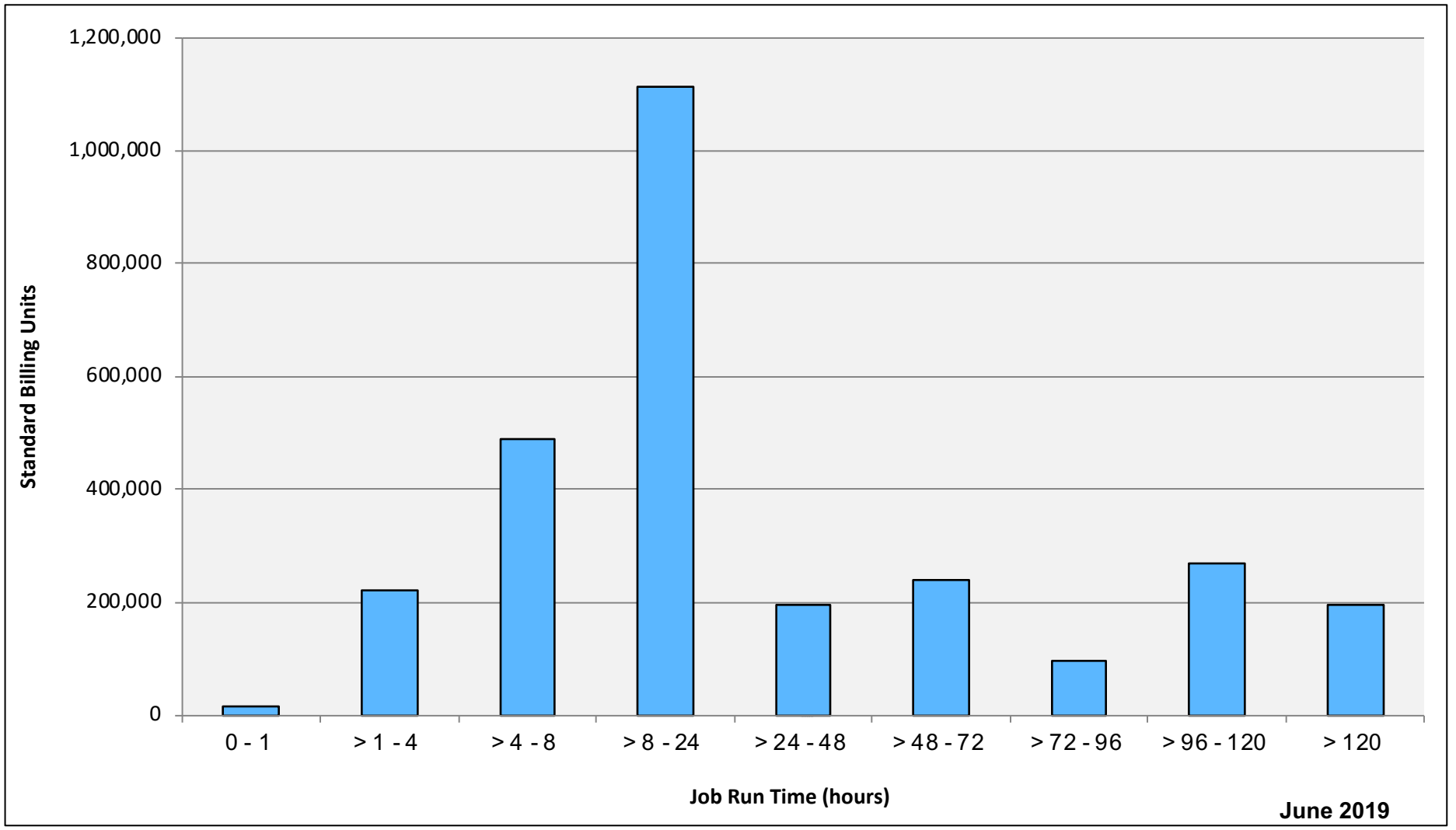
Electra:
SBUs Reported, Normalized to 30-Day Month



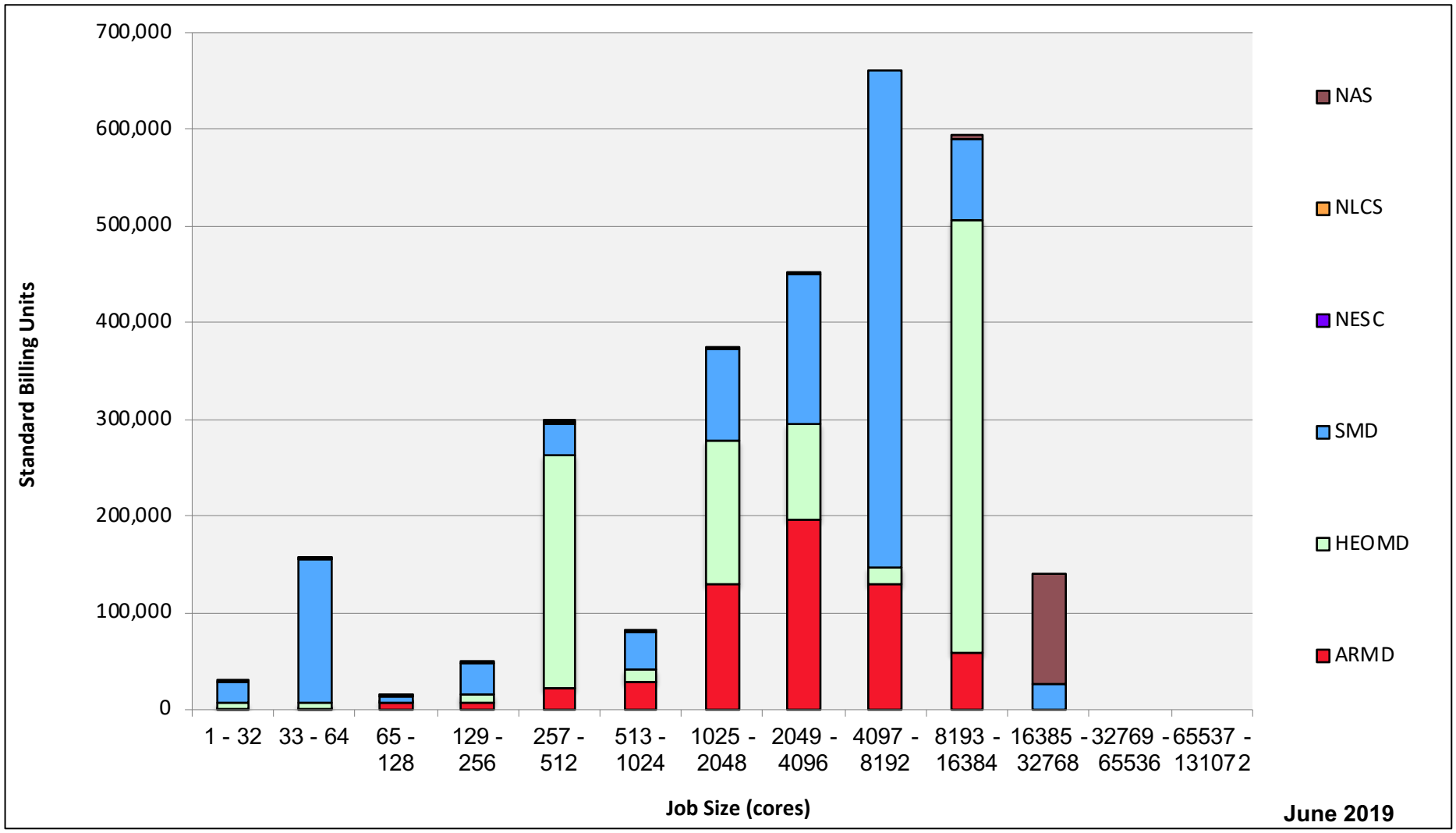
Electra:
Devel Queue Utilization



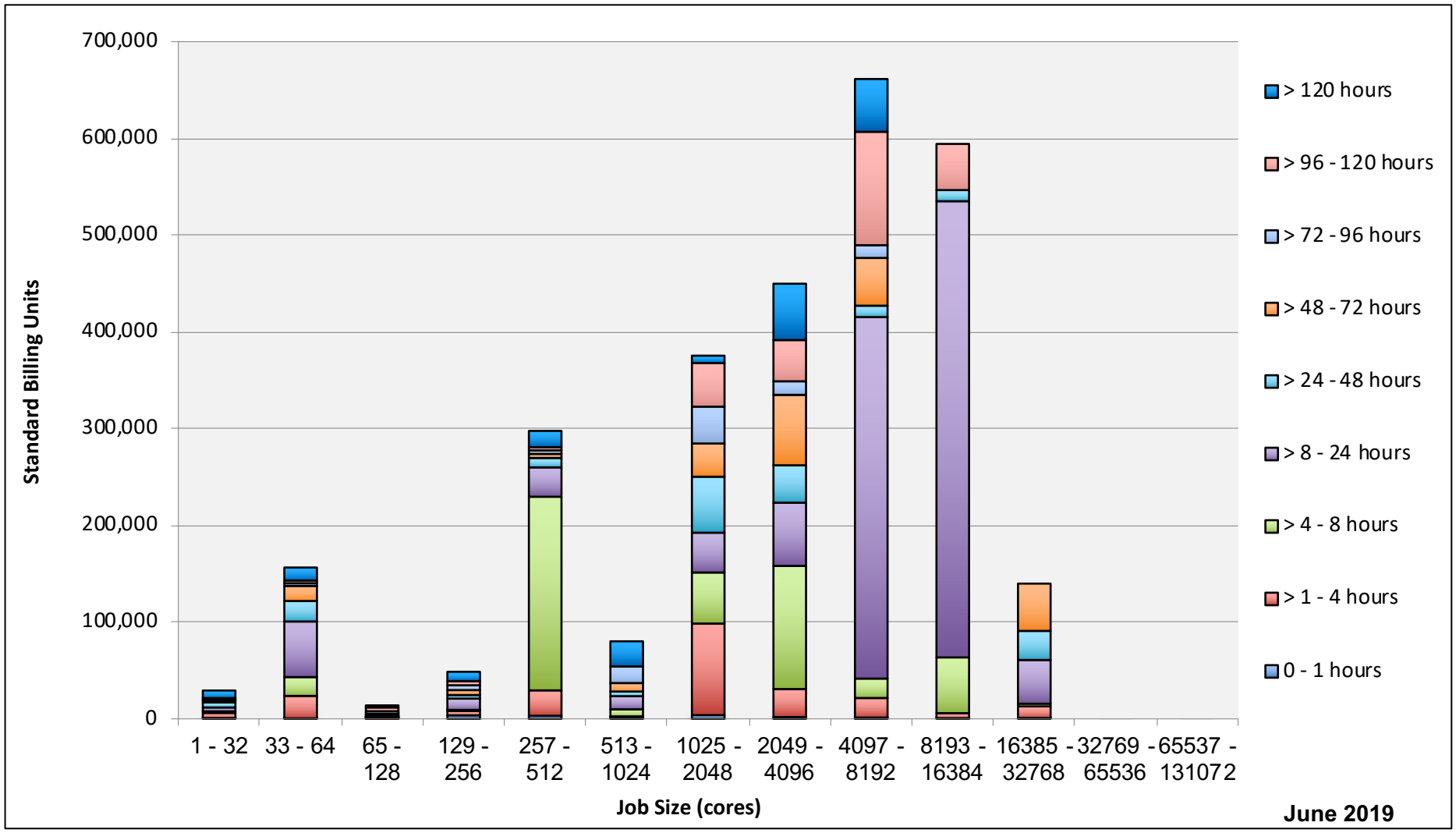
Electra:
Monthly Utilization by Job Length



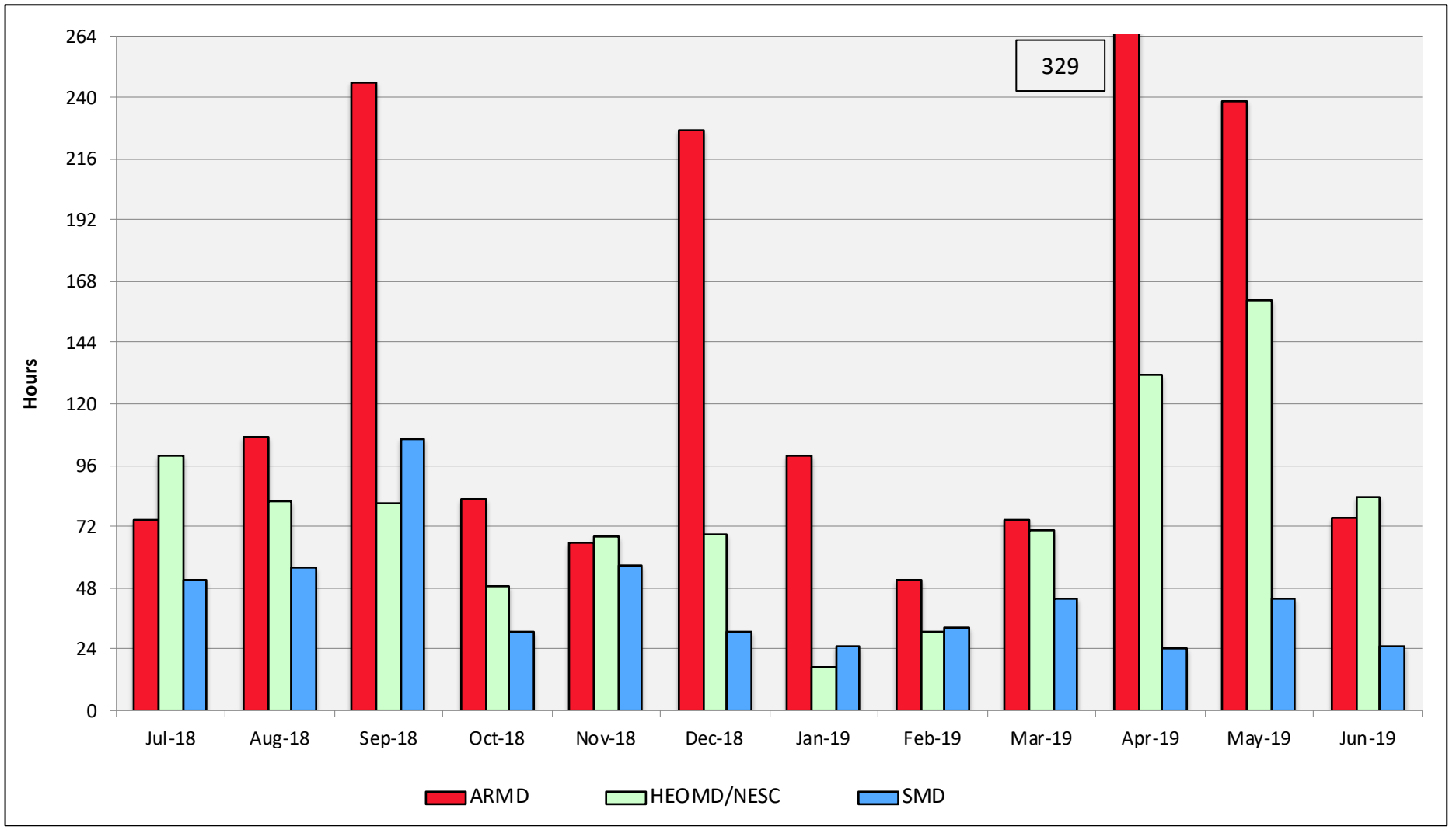
Electra:
Monthly Utilization by Size and Mission



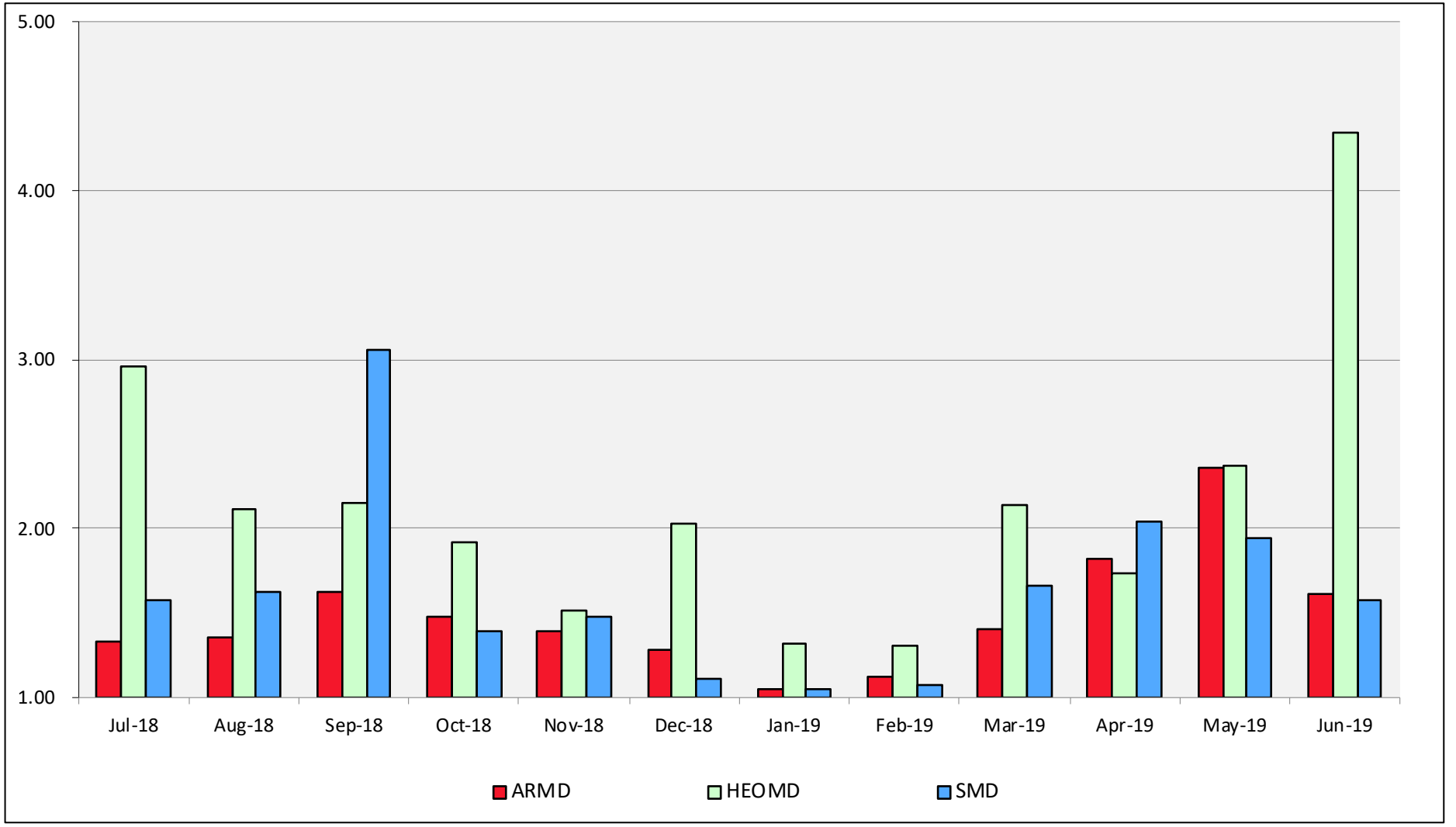
Electra:
Monthly Utilization by Size and Length



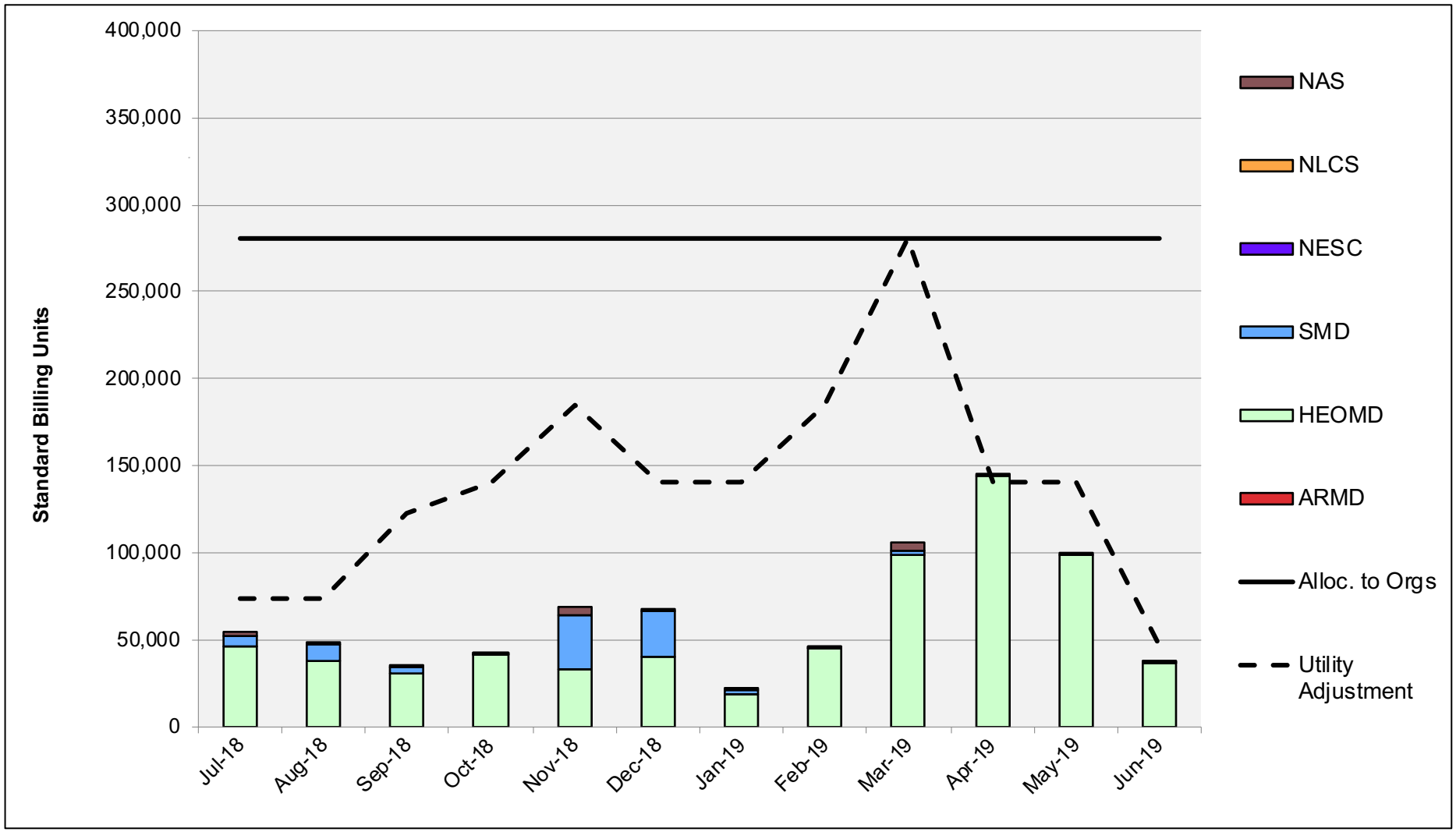
Electra:
Average Time to Clear All Jobs



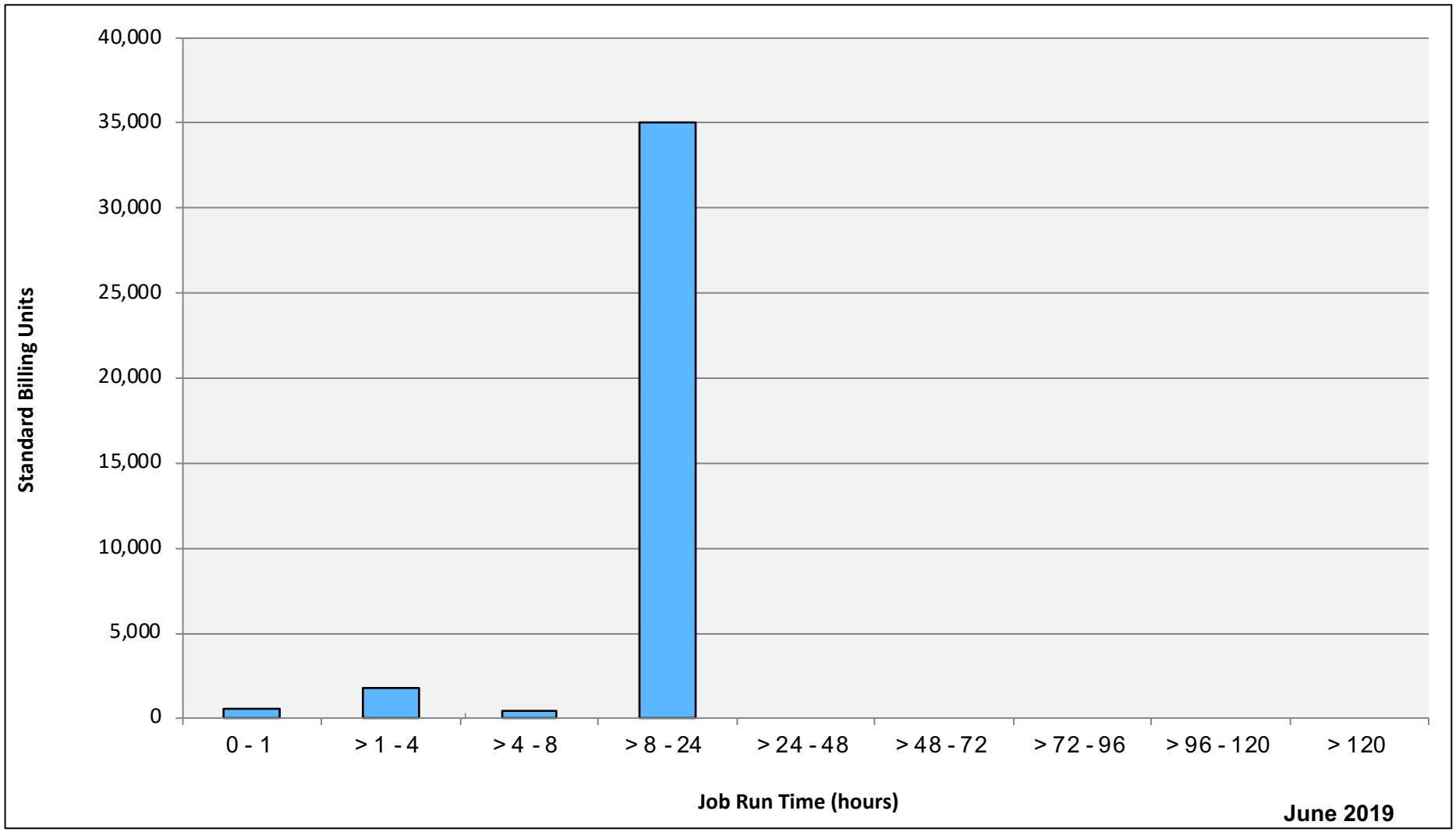
Electra:
Average Expansion Factor



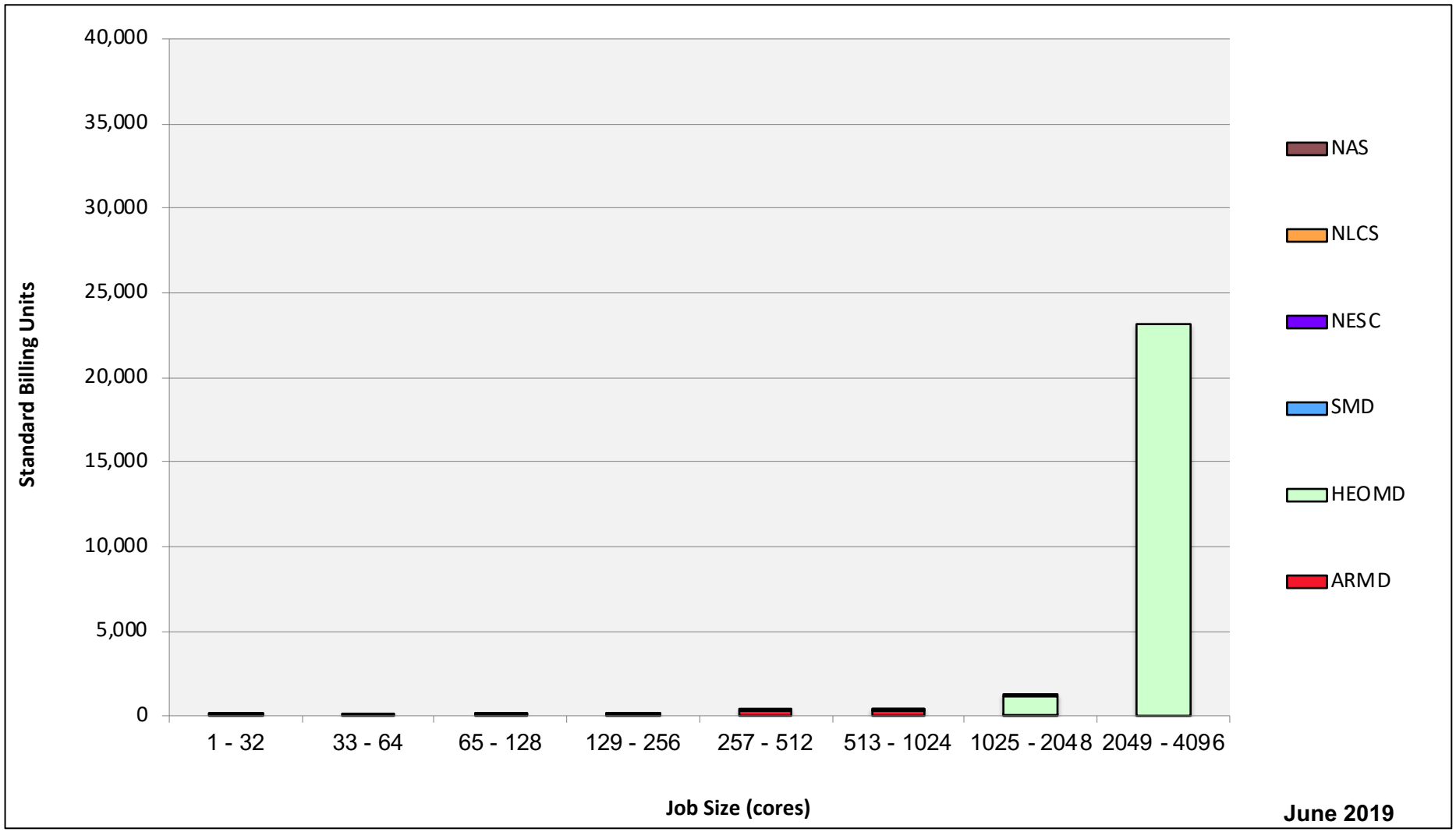
Merope:
SBUs Reported, Normalized to 30-Day Month



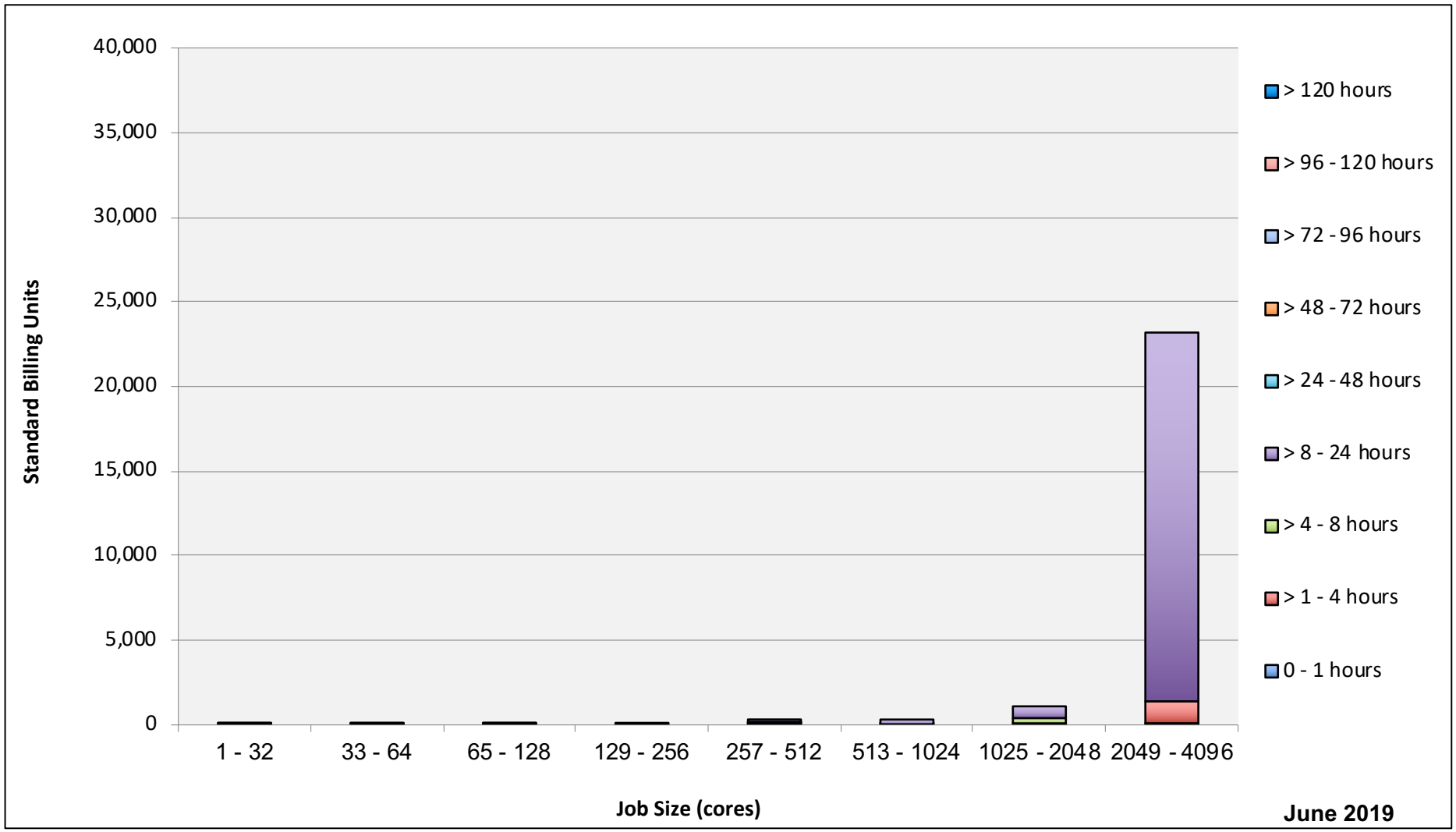
Merope:
Monthly Utilization by Job Length



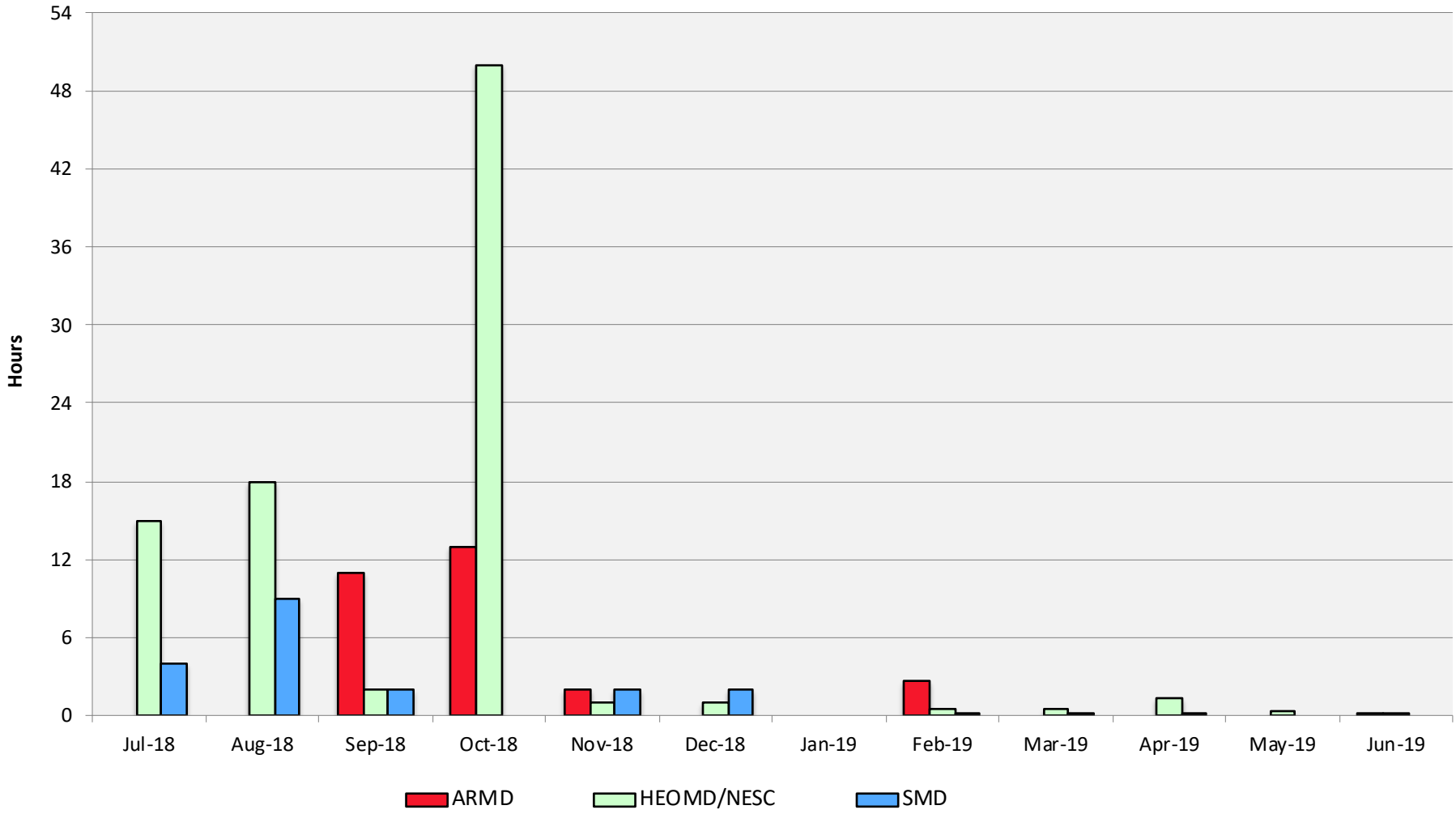
Merope:
Monthly Utilization by Size and Mission



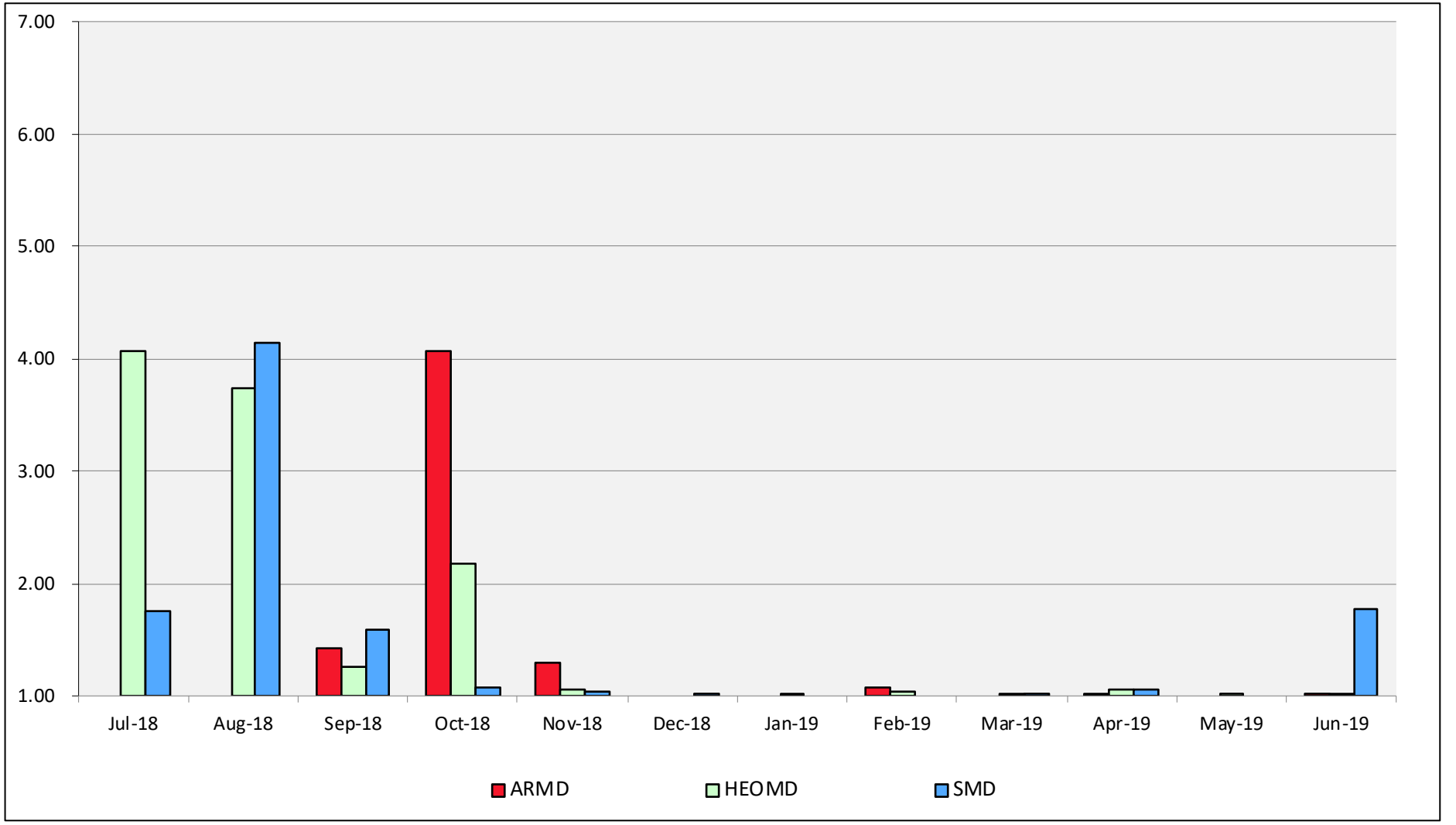
Merope:
Monthly Utilization by Size and Length



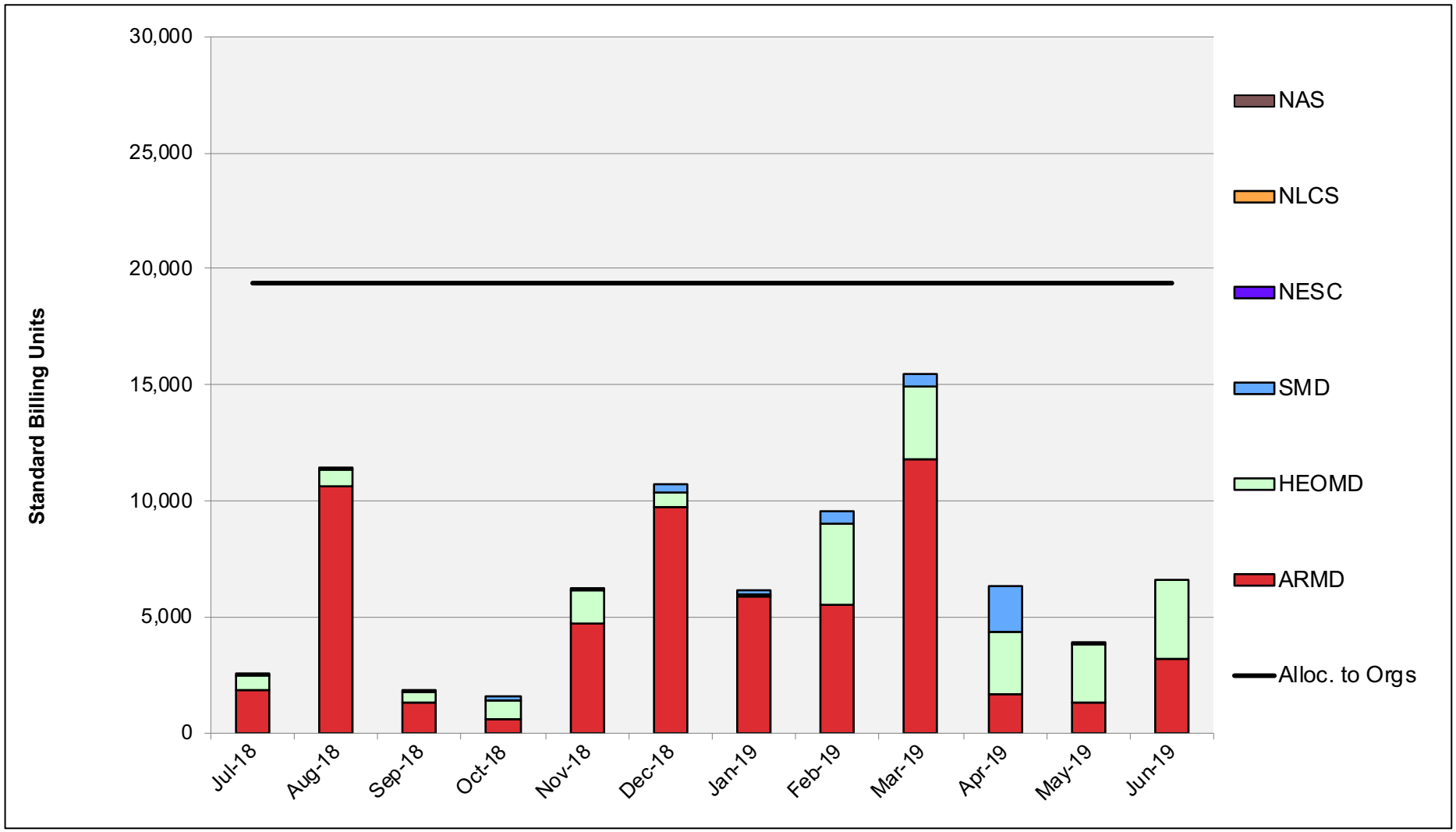
Merope:
Average Time to Clear All Jobs



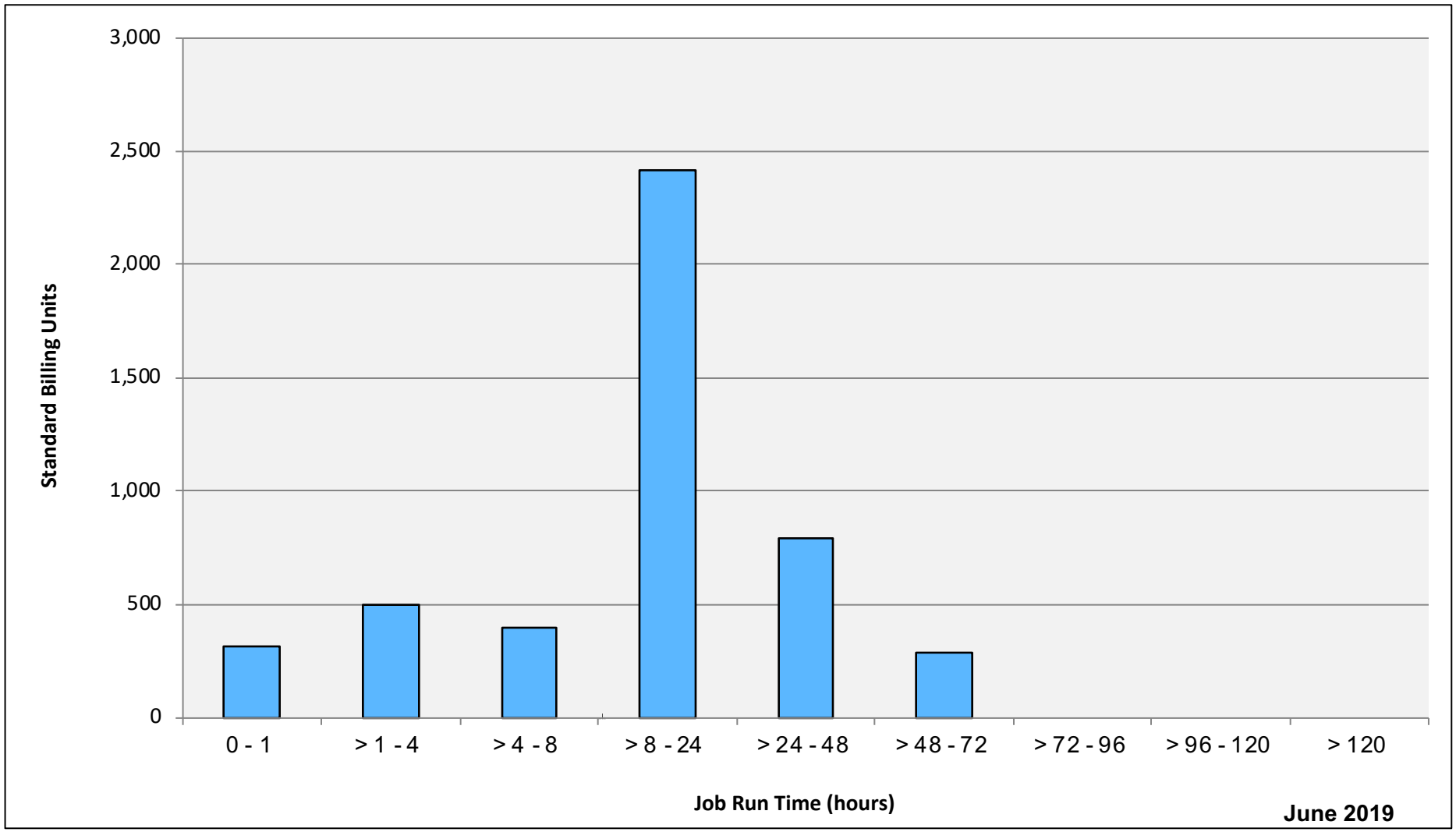
Merope:
Average Expansion Factor



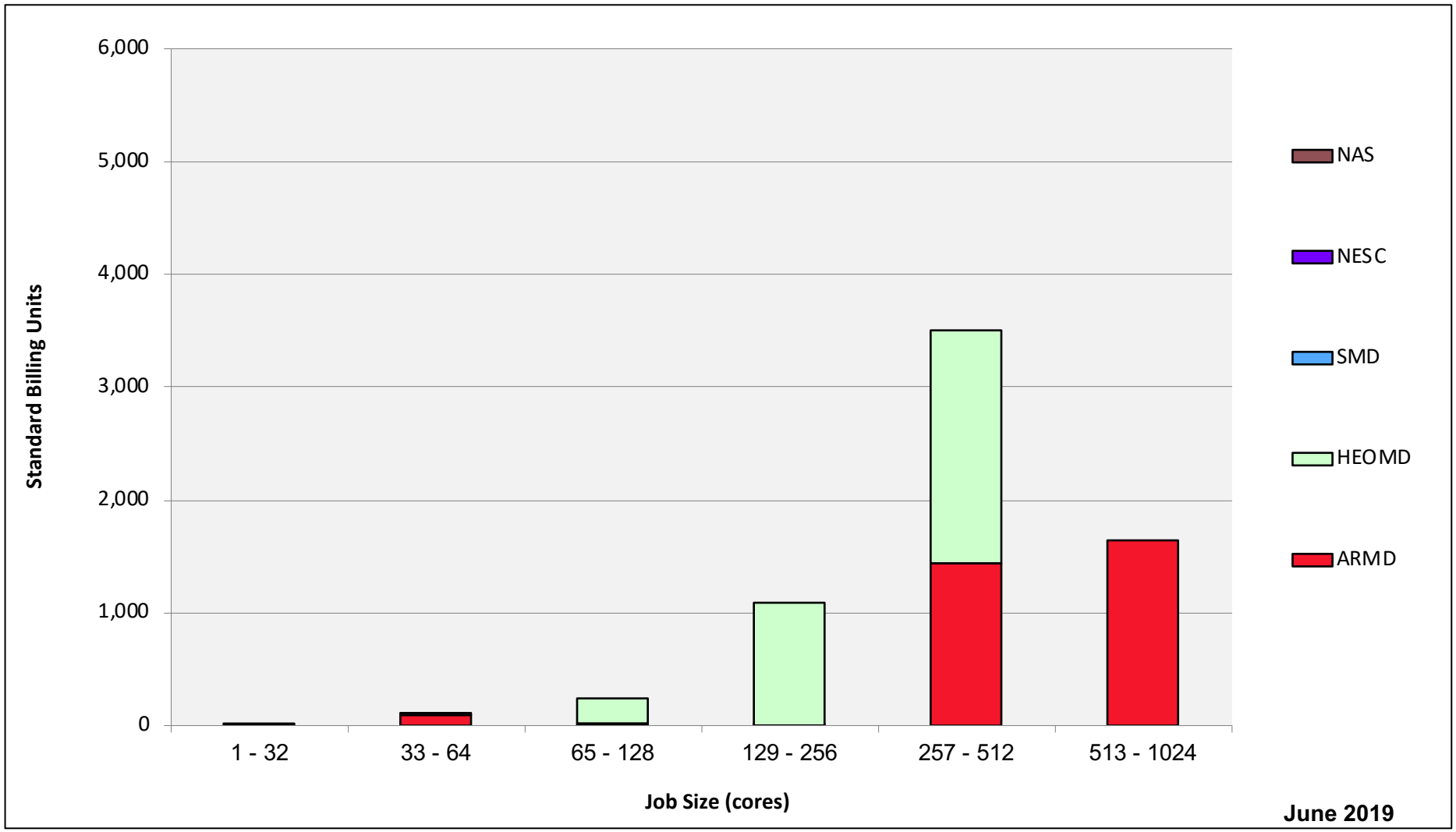
Endeavour:
SBUs Reported, Normalized to 30-Day Month



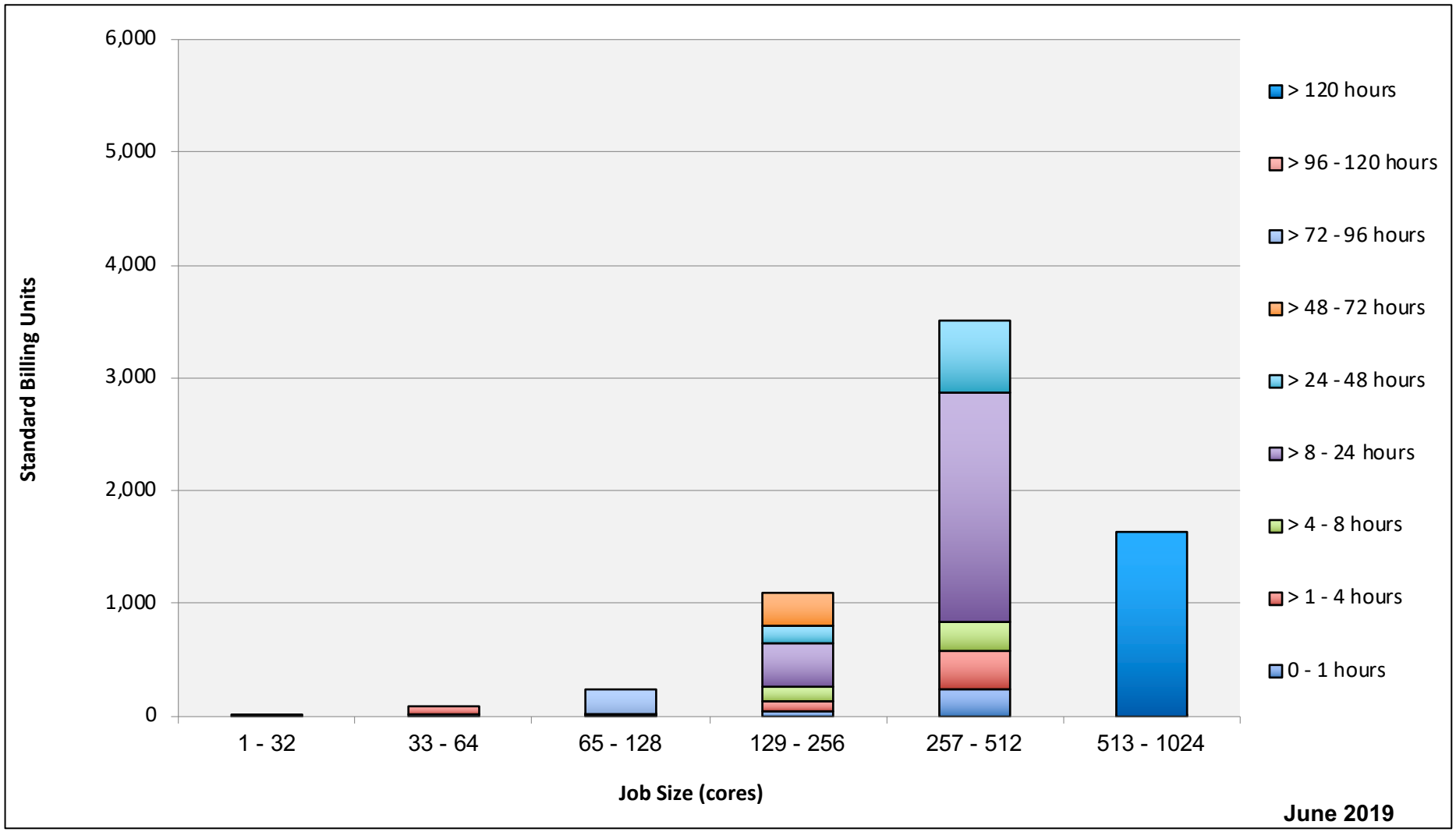
Endeavour:
Monthly Utilization by Job Length



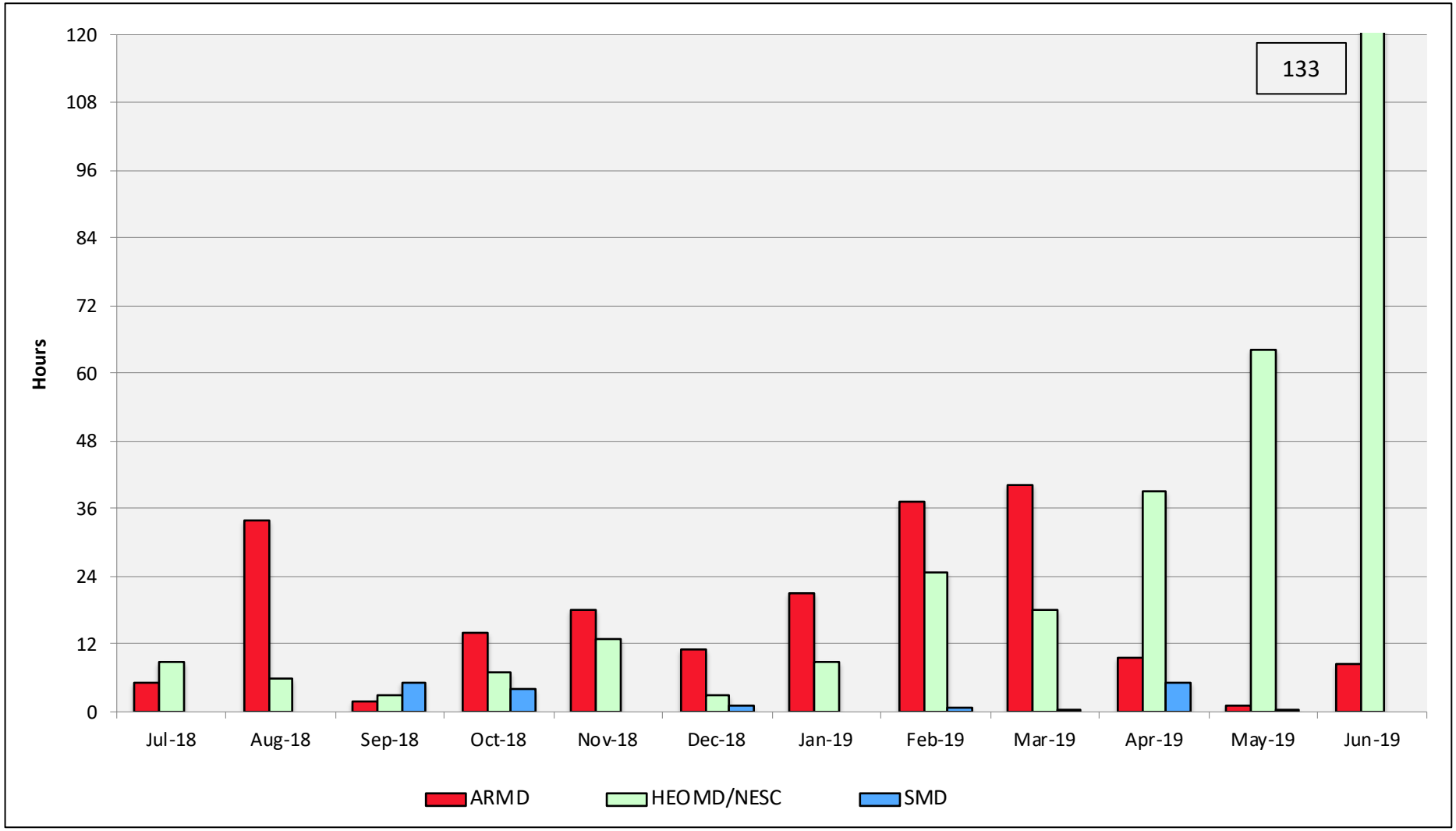
Endeavour:
Monthly Utilization by Size and Mission



Endeavour:
Monthly Utilization by Size and Length



Endeavour:
Average Time to Clear All Jobs



Endeavour:
Average Expansion Factor

