



Supercomputer  
Center

2024-2025

# RESEARCH REPORT





“The Ohio Supercomputer Center powers Ohio’s leadership in workforce development by creating high performance computing and AI education and research opportunities for college and K–12 students.”

— Mike Duffey, Chancellor,  
Ohio Department of Higher Education



The Ohio Supercomputer Center (OSC) empowers Ohio higher educational institutions and private industry by providing capable, accessible, reliable and secure computational services enhanced by training, consulting and research partnership. Through OSC’s high performance computational resources, the State of Ohio leverages significant economies of scale resulting in better services and cost savings. OSC can help position Ohio’s higher educational institutions and companies as world leaders with a computationally enabled workforce and research endeavors.

Governed by the Chancellor of the Ohio Department of Higher Education (ODHE), the Ohio Technology Consortium (OH-TECH) serves as the technology and information division of ODHE. The consortium comprises a suite of widely respected member organizations collectively unsurpassed in any other state: OSC, OARnet and OhioLINK. The consortium drives efficiencies through common services provided to member organizations through the Shared Infrastructure and Consortia Services divisions.

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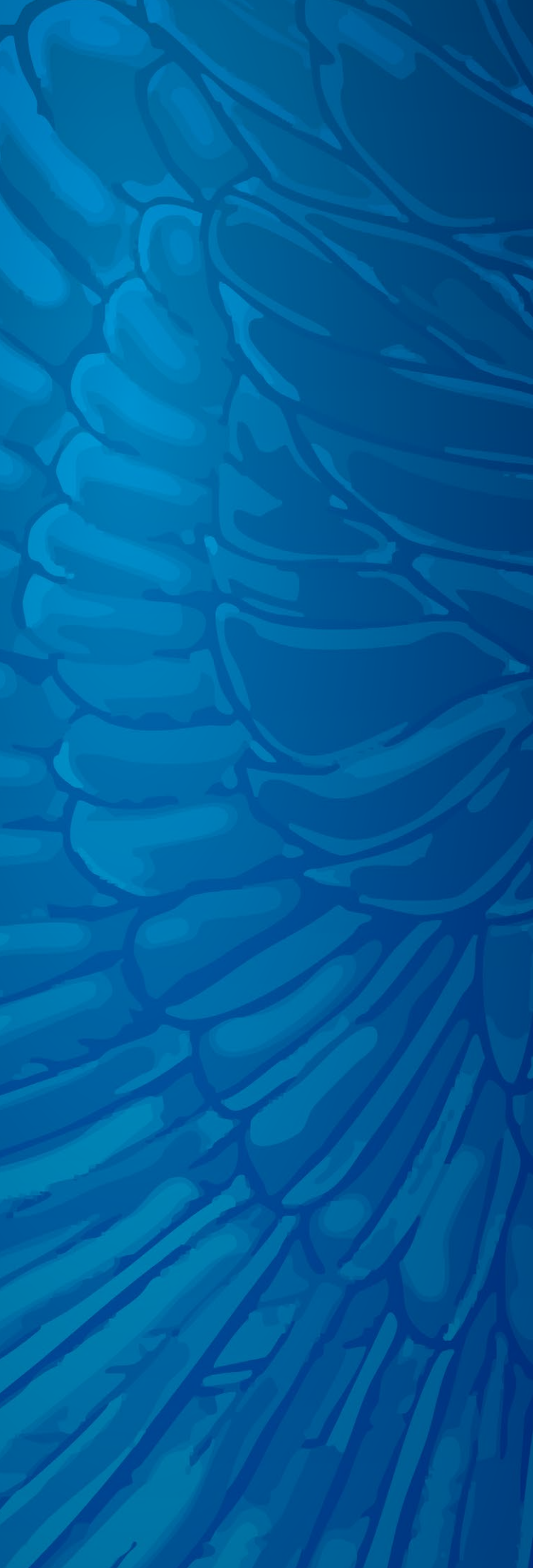
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MOSS CONNER



WREN DENNY



HANNAH DICKERSON



MINJOON LEE



SHIMA MOUSAVIZADEH MARKIEH



SARAH SHOCKEY



ADDIE SMITH



PERIDOT SMITH



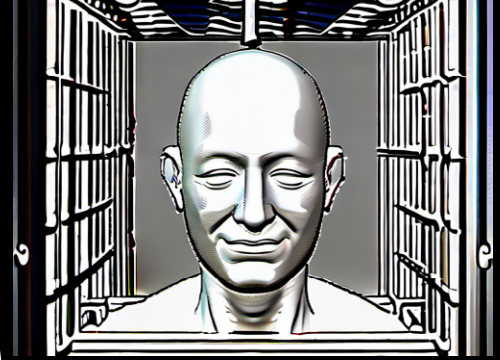
FAUN WINTHROP



FYNN WISEMAN



ESTHER YALI-WILLIAMS



MASON MAUZY



SARA PIRAHMADIAN

## Director's Letter

When the Ohio Supercomputer Center (OSC) was developing its new flagship high performance computing (HPC) cluster, Cardinal, we approached one of our higher education institution clients for a creative solution for the endcap image, the artwork that identifies the cluster in the data center. Ohio University faculty member Basil Masri Zada and students already had been using our resources to explore the application of artificial intelligence (AI) to digital artwork and enthusiastically accepted the challenge of using the technology to design an image that celebrates the cluster's avian namesake.

The end result, featured on the cover of this year's Research Report, not only is visually arresting but also represents major themes of OSC's 2024: advancements in HPC capabilities, the prominent role of AI in our client work and resource development, the expansion of HPC use beyond traditional disciplines, and our support of the next generation of Ohio innovators.

Over the last six months, OSC has launched two major HPC clusters. Cardinal, which debuted in November, features the latest technology from Dell, Intel and NVIDIA, as well as an energy-efficient cooling system that landed the cluster on the global Green500 List. In addition, last year The Ohio State University Wexner Medical Center partnered with OSC to help deploy a major expansion of our Ascend cluster, providing all OSC clients access to more GPU resources than ever before.

While it's critical to maintain advanced hardware and infrastructure in our data center, OSC also is committed to ensuring that our clients can readily access and utilize our resources. That's why we spent the past year developing a new service center, slated to launch in the coming months, that will provide world-class client support for research and education.

Open OnDemand also is an important tool that helps boost access to HPC resources—both here at OSC and for the thousands of sites around the



**David Hudak, Ph.D.**  
Executive Director

world that have adopted it. New National Science Foundation (NSF) funding for the project is helping OSC and its partners add features, support classroom deployments and increase accessibility of the platform for new users. The inaugural Global Open OnDemand (GOOD) conference, held in early 2025 at Harvard University, brought together HPC experts to share how they have adapted the platform for their local communities.

These are just a few examples of how OSC supports higher education through HPC services and research. As you'll read more in this year's Research Report, we're also involved in multiple NSF-funded initiatives to train more research computing professionals to manage AI workloads or deploy new AI tools to assist faculty and students, we host summer STEM institutes to introduce Ohio youth to HPC research and career paths, and we support thousands of Ohio college students—such as the innovative artists behind our new Cardinal endcap—on their journey to be the computationally enabled workforce of tomorrow.

Beyond these initiatives, we are excited to showcase examples of how our clients are using OSC's resources and services to make strides in research, teaching, institutional HPC support and company innovations. As we learn about the amazing outcomes of your work, we are delighted to know that we have played some part in your story.

A handwritten signature in dark ink, appearing to read "David Hudak". The signature is fluid and cursive, written on a light-colored background.

**David Hudak, Ph.D.**  
Executive Director

ON THE COVER: Ohio University Digital Art and Technology students and faculty member Basil Masri Zada designed the endcap for OSC's newest high performance computing cluster, Cardinal, using the cluster's own advanced artificial intelligence capabilities.

# IMPACT

OSC serves higher education, nonprofit, government, education and commercial communities in Ohio, with services available to clients across the nation and globe. From hardware and software offerings, computing resources and data storage, to training and educational opportunities, OSC continued to make a measurable impact on clients' discovery, learning and innovation in the last year.



**\$8.5+ MILLION**  
ESTIMATED ANNUAL COST SAVINGS  
COMPARED TO COMMERCIAL CLOUD



**7,918**  
CLIENTS



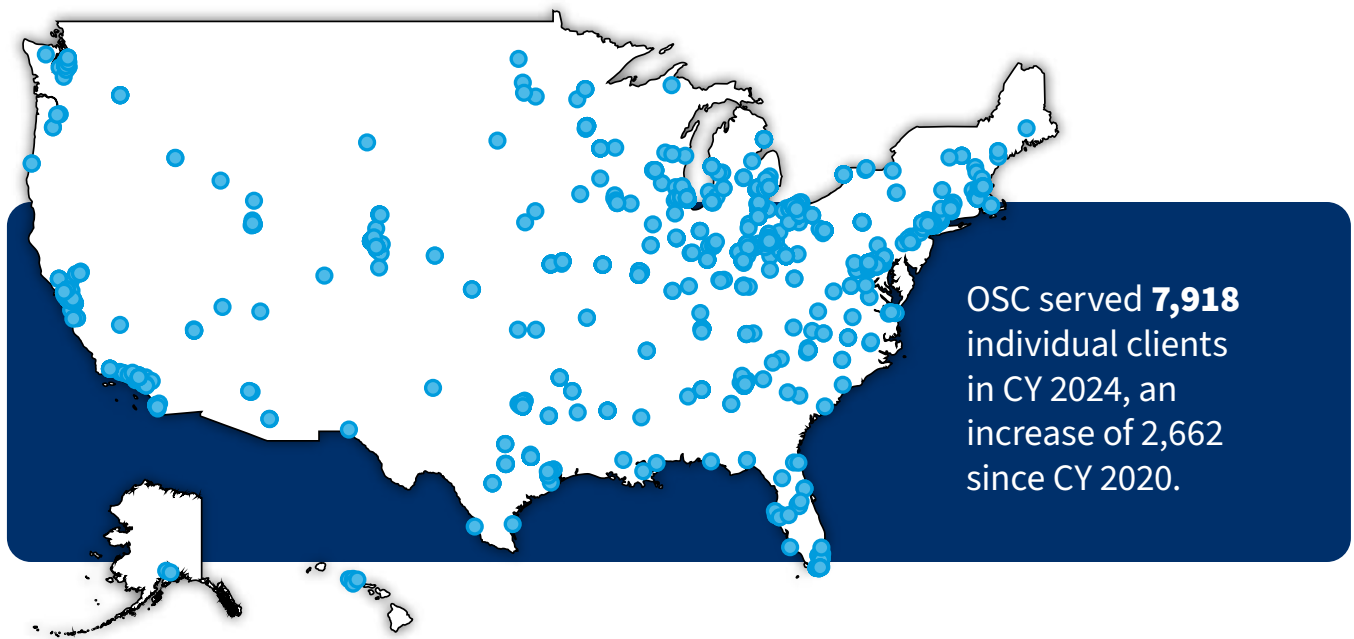
**77**  
TRAINEES



**294**  
COLLEGE COURSES  
USED OSC RESOURCES



**8**  
TRAINING  
OPPORTUNITIES



## Hardware

### Cardinal Launch

In November 2024, OSC launched its new flagship HPC cluster, Cardinal, designed to meet the growing computational needs of AI and machine learning research. Cardinal is a 39,312-core, 378-node Dell PowerEdge with Intel CPU Max 9470 HBM machine with a theoretical system peak performance of 10.5 petaflops. The cluster boasts a 140% increase in computing power over OSC's previous systems and features enhanced GPU capabilities. Clients have reported significant improvements in processing power and speed for academic and commercial projects. Cardinal also has gained attention in the international HPC community, as it was ranked No. 211 on the Top500 List and No. 15 on the Green500 List for energy efficiency. Cardinal, which has replaced the Owens cluster, joins the Pitzer and Ascend clusters at the OSC data center.

### Next-Generation Ascend Debut

In collaboration with The Ohio State University Wexner Medical Center and College of Medicine, OSC significantly expanded its HPC resources on the Ascend cluster for all academic and commercial clients to access in early spring 2025. The next-generation Ascend, a ~13 petaflop system, features advanced hardware, including AMD EPYC processors and NVIDIA GPUs that support AI, machine learning and medical

research. The cluster's power has increased sixfold, has reduced wait times and features streamlined workflows.

## OnDemand

### NSF Supports Platform Advancements

The National Science Foundation (NSF) awarded \$5 million to OSC, the Massachusetts Green High Performance Computing Center (MGHPCC), Texas A&M University and the University of Maryland over the next five years to enhance the Open OnDemand web portal, which is now deployed at thousands of sites worldwide, supporting at least half a million researchers and students. The new initiative aims to add features, foster scientific collaborations and increase accessibility of the platform to new users. Key projects will focus on app development, classroom deployment, multi-language support and community engagement.

**6,134 enrollees**

from **36** organizations  
participated in courses  
using OSC resources





### Inaugural GOOD Conference

The first-ever Global Open OnDemand (GOOD) conference was held at Harvard University from March 17–20, 2025. The event brought together the community that uses OSC’s web portal to share expertise and learn about advancements in the technology. The conference, which attracted 170 attendees, featured talks, tutorials, networking opportunities and a “contributor jam” to engage more community members in Open OnDemand development. Sessions explored topics such as customization, apps, educational usage, client impacts, security and data privacy, cloud integration and core development.

### Open OnDemand Version 4.0

OSC launched version 4.0 of Open OnDemand, which includes enhancements such as support for required and dismissible announcements, an updated file editor interface, an enhanced XDMoD job efficiency widget, improved customization for interactive applications and better system operations. OSC’s developers have worked with HPC community members at institutions such as Harvard University’s Institute for Quantitative Social Science and CSC – IT Center for Science in Finland to make advancements to the platform to help research computing centers better customize features for their unique users and enhance system operations.

### HPCWire Readers’ Choice Award

The Open OnDemand web portal was recognized in the 2024 HPCwire Readers’ Choice Awards at the SC24 conference in Atlanta, Georgia. The award, in the category of Readers’ Choice: Top 5 New

Products or Technologies to Watch, recognizes the portal’s impact on HPC in the global community.

## Client Services

### New Service Portal

OSC has developed a new web-based service center to enhance the overall support experience for clients. With HPC credentials, clients can open and manage cases, view all current and past cases, communicate directly with OSC staff, request various services and access relevant documentation. The center, which will launch in the coming months, aims to streamline the support process, making case resolutions quicker and more efficient. Additionally, a new entry point for prospective clients, [start@osc.edu](mailto:start@osc.edu), will help new users onboard with OSC.

## Research Partnerships

### Cyberinfrastructure Training, Support

OSC staff continued to participate in several NSF-funded partnerships with Ohio and U.S. universities designed to provide more tools and training to the cyberinfrastructure professionals at research computing centers. These initiatives help HPC centers support the growing number of academic researchers who use their services and resources, particularly in the areas of AI and machine learning. The collaborations include the OH-SCiPE project, an effort with Case Western Reserve University and University of Cincinnati to support the research community in leveraging AI advancements in their research workflows;



The inaugural Global Open OnDemand (GOOD) conference attracted 170 attendees who discussed how they are implementing the Open OnDemand web portal at their HPC centers to support research, teaching and innovation.

the ACCESS project, an initiative led by the University of Colorado Boulder to reimagine cyberinfrastructure user support services and delivery to keep pace with the evolving needs of academic scientific researchers; and the Rutgers University-led hpcGPT project, an HPC-enriched generative AI program that can provide technical support to HPC center users.

## AI Research

The NSF-funded Artificial Intelligence (AI) Institute for Intelligent Cyberinfrastructure (CI) with Computational Learning in the Environment (ICICLE) project completed its third year of work, with a focus on interdisciplinary collaboration within the large team and implementation of cyberinfrastructure components into real-world use cases. ICICLE, which draws on OSC's resources and staff expertise, strives to enhance the accessibility of AI by developing cyberinfrastructure across three initial domains of focus: smart foodsheds, digital agriculture and animal ecology.

## Engagement and Outreach

### Client Engagement

The inaugural Research Symposium, held in April 2024, attracted two dozen talks and poster presentations from faculty, staff and students at higher education institutions across Ohio. The event, which will occur annually in the spring, offers an opportunity for members of the research community to share how they are using HPC to advance work across many disciplines. In addition, OSC hosted its first Community Briefing in fall 2024, which highlighted the significant changes



Students enrolled in the STEM Institute tour research facilities at The Ohio State University and participate in team projects that use supercomputers to solve complex science and engineering problems.

underway for its research computing hardware environment at the data center.

## Industry Conferences

OSC engaged with the national research computing community in 2024 through four major conferences: ISC High Performance, PEARC, Gateways and SC24. Staff showcased Open OnDemand and participated in various presentations, panel discussions and workshops. These conferences provided opportunities for OSC to connect with researchers, developers and industry leaders, fostering collaboration and innovation in high performance computing.

## Summer Youth Programs

Interest in OSC's summer youth education programs remained strong in 2024, with dozens of students across Ohio participating in summer camps that allowed them to explore topics such as watershed science, HPC, data analysis, cybersecurity and machine learning. For 2025, OSC has renamed these programs the STEM Institute (for ninth, tenth and eleventh grades) and Youth STEM Institute (for sixth and seventh grades) to help connect more Ohio youth with these educational opportunities.

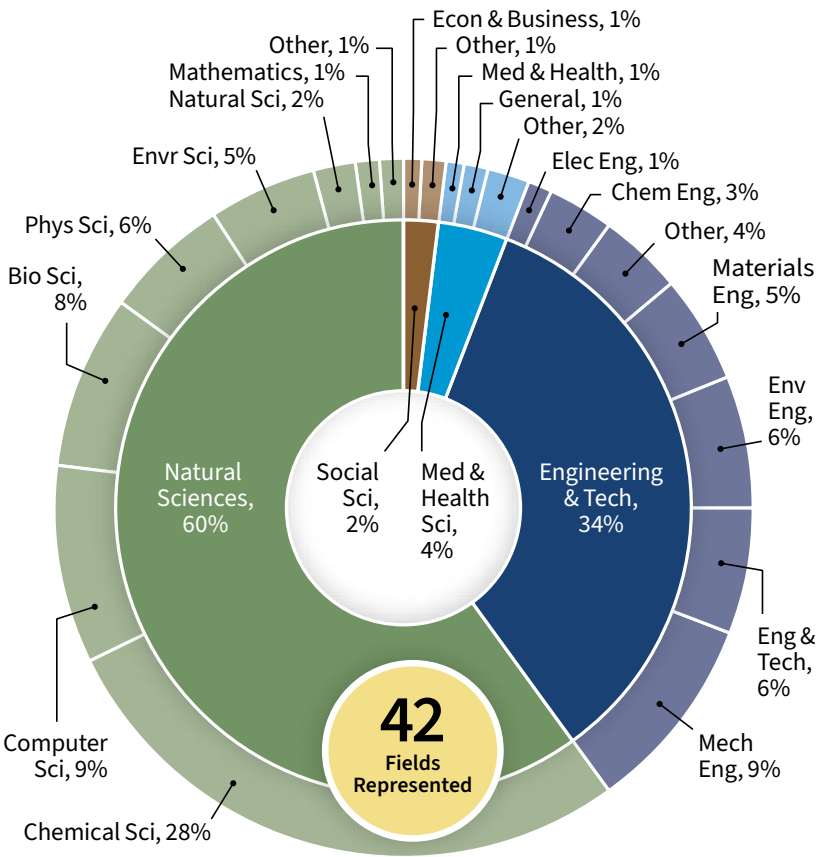
## State of Ohio Outreach

The Ohio Technology Consortium and OSC, in collaboration with the Ohio Department of Higher Education, debuted the "Universe of Opportunity" virtual reality experience at the 2024 Ohio State Fair. The experience offers tours of Ohio's two- and four-year colleges, universities and technical centers to help the public explore the state's comprehensive higher education system.



The Youth STEM Institute allows students to explore an Ohio watershed and analyze data to understand land use, water quality and habitat issues.

# Usage by Field of Study



## Client Scholarship



**1,045**  
PUBLICATIONS



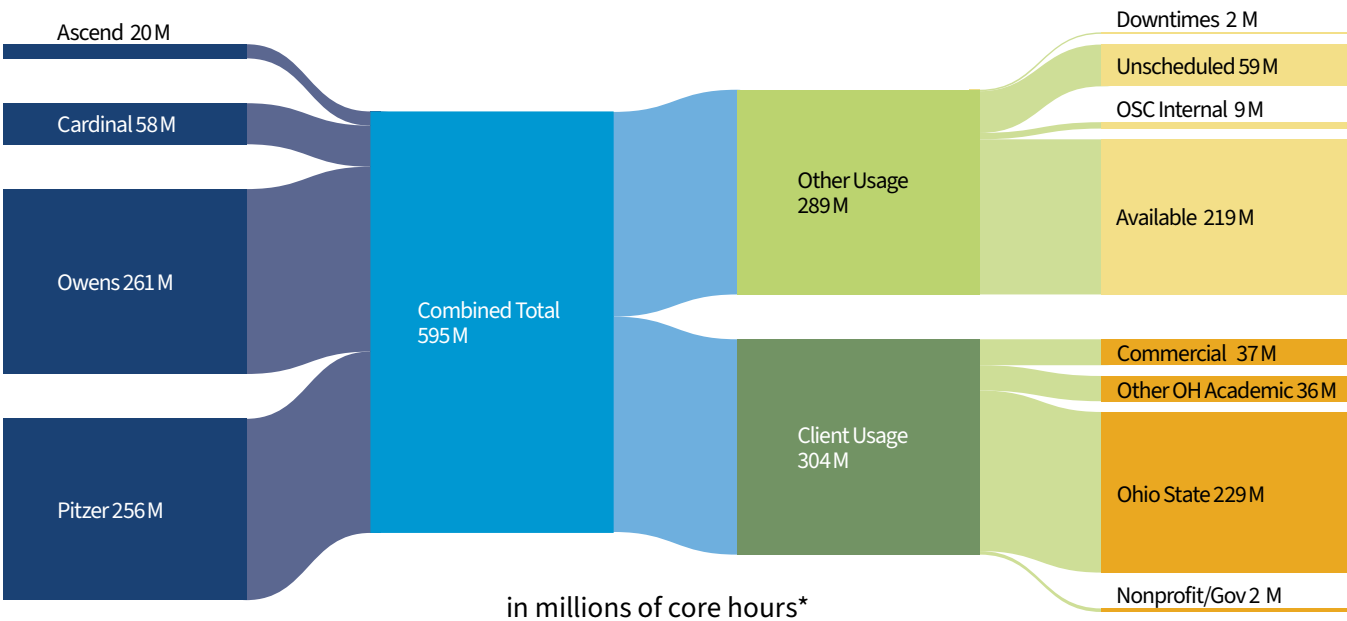
**336**  
VENUES



**6,250**  
CITATIONS

*Data from CY2022–CY2024*

# Overall System Usage



*\* All data: CY2024*



# CLIENT RESEARCH SPOTLIGHTS

## University of Wisconsin-Eau Claire

When Tyler Bauer helped introduce Open OnDemand to the University of Wisconsin-Eau Claire, he saw an immediate transformation. Students who once struggled with command-line interfaces when using HPC resources began diving into data effortlessly. The adoption of Open OnDemand paved the way for a bioinformatics major, a data science course and even outreach programs for high school students at the university. In Upward Bound workshops, teens navigated HPC resources with newfound confidence. Bauer calls the platform a “game-changer,” not just for simplifying research but for empowering students to explore HPC’s possibilities. With plans to customize the platform further, Bauer envisions an even brighter future for HPC use on campus.

[osc.edu/uwec](https://osc.edu/uwec)

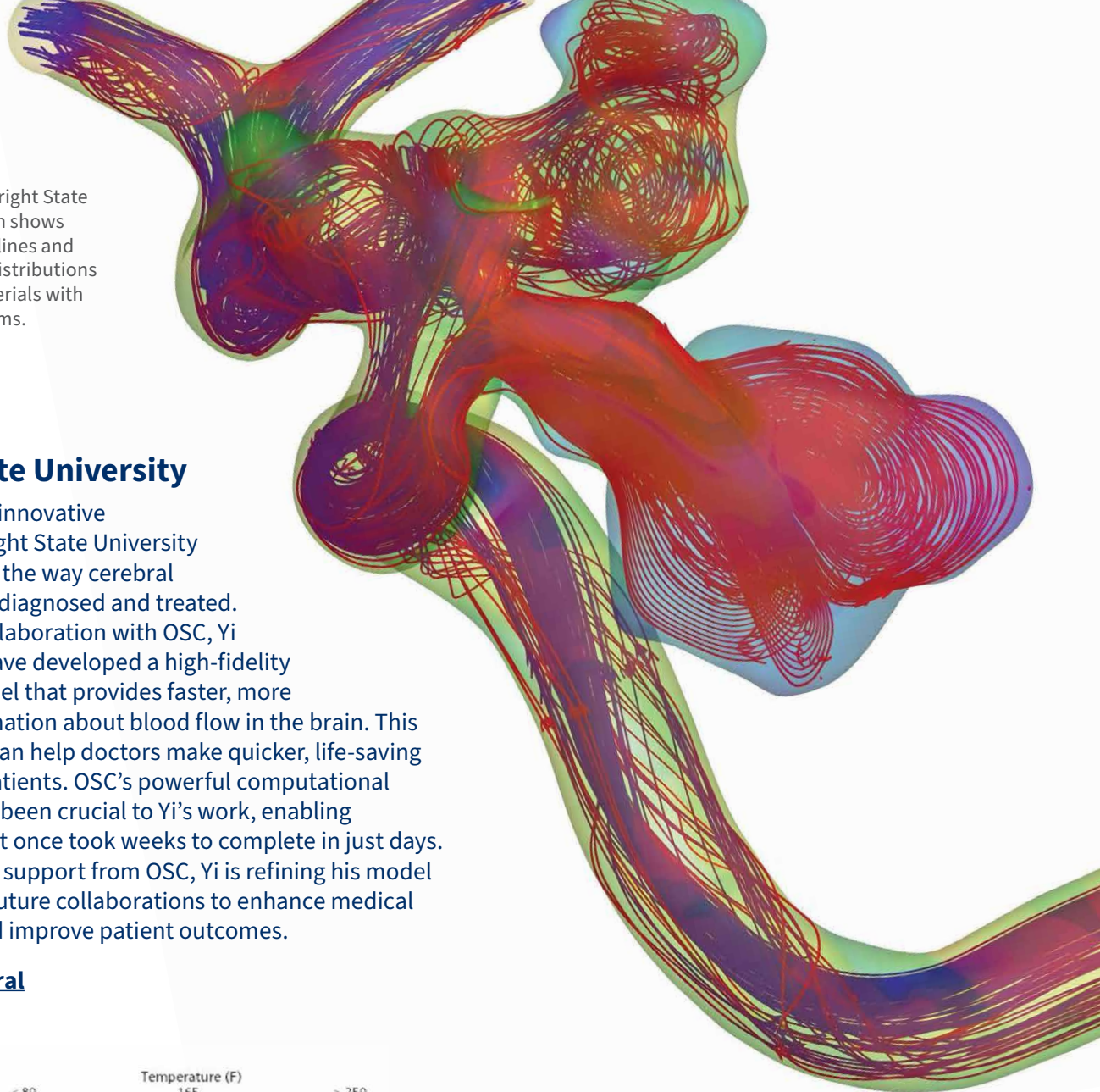
ABOVE: A University of Wisconsin-Eau Claire research group led by Assistant Professor of Geography and Anthropology Papia Rozario extensively uses Open OnDemand for one of their projects.

This image from Wright State University research shows blood flow streamlines and wall shear stress distributions at the cerebral arterials with aneurysm symptoms.

## Wright State University

Hang “Bill” Yi’s innovative research at Wright State University is transforming the way cerebral aneurysms are diagnosed and treated. Through his collaboration with OSC, Yi and his team have developed a high-fidelity diagnostic model that provides faster, more accurate information about blood flow in the brain. This advancement can help doctors make quicker, life-saving decisions for patients. OSC’s powerful computational resources have been crucial to Yi’s work, enabling simulations that once took weeks to complete in just days. With continued support from OSC, Yi is refining his model and exploring future collaborations to enhance medical diagnostics and improve patient outcomes.

[osc.edu/cerebral](https://osc.edu/cerebral)



TotalSim model shows the impact of design changes on race car cabin temperatures.

## TotalSim and NASCAR

In the world of NASCAR, every fraction of a second counts. In 2022, a new challenge emerged with the introduction of the NextGen race car. The design overhaul restricted airflow, creating excessive heat in the cockpit and affecting driver performance. NASCAR turned to Ohio company TotalSim for help, and OSC’s powerful computational resources became crucial in finding a solution. By running detailed simulations, TotalSim tested several design options, including a short exhaust system to redirect heat. Thanks to OSC’s computational power, the team accelerated their analysis, helping NASCAR implement an effective solution now seen on the track.

[osc.edu/nascar](https://osc.edu/nascar)



The Institute for Cyber-Enabled Research at Michigan State University uses OSC's Open OnDemand web portal to help researchers and students access and use its HPC resources.

## Michigan State University

Michigan State University (MSU) is expanding HPC access with the NSF-funded Data Machine, which hosts Open OnDemand. Aimed at researchers in diverse fields, including social sciences, the initiative helps users analyze large datasets and integrate AI and machine learning into their work. Open OnDemand provides an easy-to-use interface, allowing students and faculty to run computations without needing extensive HPC expertise. MSU's Institute for Cyber-Enabled Research (ICER) has leveraged the portal to streamline software access and improve productivity. By broadening HPC adoption, MSU aims to support research, curriculum integration and faculty recruitment across multiple disciplines.

[osc.edu/msuood](https://osc.edu/msuood)

## The Ohio State University/ICICLE

The NSF-funded ICICLE project, led by The Ohio State University, is making AI more accessible for agriculture with support from OSC. By analyzing drone imagery with AI, researchers create infrared maps to help farmers detect crop stress, optimize irrigation and reduce waste. OSC's computing power enables the processing of massive datasets, providing timely insights that traditional methods cannot. Beyond agriculture, ICICLE is developing adaptable AI workflows for various industries. As a core collaborator, OSC contributes computing resources, data storage and research software expertise, helping bridge the gap between AI technology and practical, real-world applications.

[osc.edu/icicle](https://osc.edu/icicle)

## The University of Toledo

Anju R. Gupta's Interfacial Thermal and Transport Laboratory at The University of Toledo is pioneering sustainable water treatment solutions by developing advanced mixed matrix membranes for desalination. Using OSC resources, Gupta and her team applied machine learning and statistical forecasting to predict membrane lifespans, significantly improving water quality and yield. Their work, funded by the NSF, includes prototypes that not only enhance desalination but also recover valuable materials from wastewater. Gupta's research combines innovation with sustainability, aiming to transform wastewater into clean water while addressing environmental and societal challenges.

[osc.edu/watertreatment](https://osc.edu/watertreatment)

## The Ohio State University

Sultana Nahar's research on the sun's opacity and iron processes is unraveling the mysteries of solar physics, thanks to support from OSC. With a focus on atomic data, Nahar's work advances our understanding of the sun's physical composition and chemical evolution. OSC's computational resources have been essential in helping the research team examine various issues, including the photoionization processes in stars. The team's findings have implications for space exploration, nuclear fusion energy and medical radiation therapy. Nahar's discoveries continue to push the boundaries of solar research.

[osc.edu/sun](https://osc.edu/sun)



LUMI, one of the pan-European pre-exascale supercomputers of the European High Performance Computing Joint Undertaking (EuroHPC JU), is one of three supercomputers at CSC - IT Center for Science in Finland that have integrated Open OnDemand.

## CSC – IT Center for Science, Finland

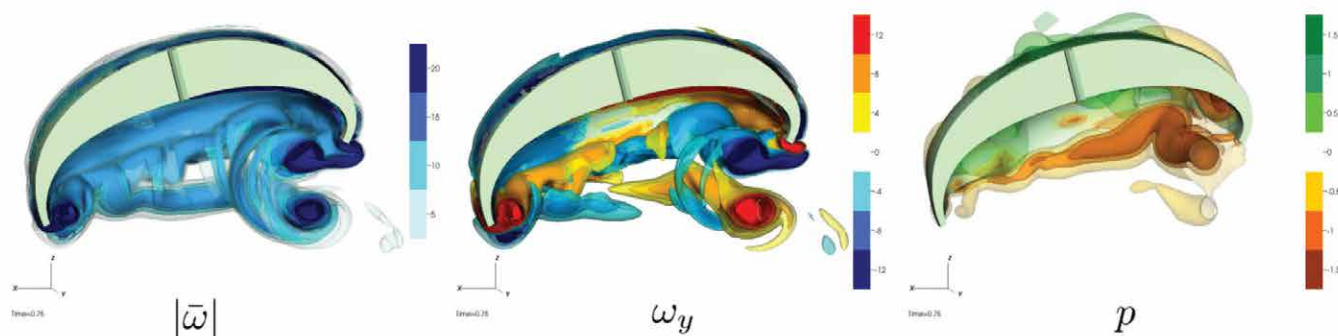
CSC - IT Center for Science in Finland manages three supercomputers, including LUMI, Europe's fastest. Since 2021, CSC has integrated Open OnDemand into its computing environments, beginning with the Puhti supercomputer and expanding to Mahti and LUMI. Open OnDemand has grown rapidly, now supporting 50% of Puhti's users, many of whom rely on it for tasks such as running Jupyter environments and data management. CSC's collaboration with OSC has led to new features, including improved remote file browsing through Rclone integration. Open OnDemand has helped CSC engage new users, including those with no Linux experience, and streamline its operations.

[osc.edu/csc](https://osc.edu/csc)

## Cleveland State University

Studying the mechanics of how marine organisms such as jellyfish move, Alexander Hoover at Cleveland State University uses OSC's supercomputing resources to run complex 3D simulations, which have significantly advanced his research. His findings on jellyfish neuromechanics have the potential to inspire innovations in biomedical technology, such as soft robotics and tissue-engineered pumps. Collaborating with oceanographers and marine biologists, Hoover continues to explore the fluid dynamics and biomechanics of marine life. Through OSC's support, Hoover is also integrating computational science into Cleveland State's programs, offering students hands-on experience with supercomputing resources.

[osc.edu/marine](https://osc.edu/marine)



Research at Cleveland State University reveals how vorticity, pressure and fluid flow influence the turning rate of jellyfish.

# RESOURCES

Current and prospective clients can take advantage of OSC's many technical resources, from computing clusters and hardware services to software packages and web portals. OSC also supports clients by providing easy access to technical expertise, workshops, training sessions and educational and networking events.



**311 M+**

CLUSTER CPU  
CORE HOURS



**2.4 M+**

GPU HOURS  
CONSUMED



**91%**

OF JOBS STARTED  
WITHIN 30 MINUTES



**99.7%**

AVAILABILITY



**28 PB**

TOTAL DATA  
STORED



**10 PB**

DATA TRANSFERRED



**1,102**

SOFTWARE  
PACKAGE VERSIONS



The spring Research Symposium invites clients to share how they have used HPC resources to advance their research or support education at their institutions.

## Education & Training

### Workshops and Training

Clients and potential users can register for workshops, one-on-one classes, web-based training and consulting services. Topics include getting started using OSC, containers for research computing and performance tuning.

### Virtual Computer Labs

Faculty and instructors can request classroom accounts for students to use HPC resources in research or coursework at no cost.

### Research Symposium

Students, faculty and staff can present their research at the spring Research Symposium, which allows researchers from across Ohio to share their findings and learn about advancements in supercomputing.

### Youth STEM Programs

Middle school and high school teens in Ohio can apply to participate in the STEM Institute (SI) or Youth STEM Institute (YSI) to gain experience with STEM research that can help them choose educational and career paths.

## Client Support

### Office Hours

Speak directly with OSC experts through virtual consultations. Contact [oschelp@osc.edu](mailto:oschelp@osc.edu) to sign up for a time.

## Technical Support

Get support for training, onboarding for new users, system status updates and resolution of issues such as debugging, software installation and workflow improvements.

- Getting Started Guide: [osc.edu/start](https://osc.edu/start)
- Technical Support: [osc.edu/support](https://osc.edu/support)
- OSC Help Desk: Basic and advanced support, Monday through Friday, 9 a.m. to 5 p.m., [oschelp@osc.edu](mailto:oschelp@osc.edu) or 614-292-1800.

### Consulting

Consult with OSC staff experts on HPC and software engineering issues, including optimizing code and debugging.

### Research Collaboration

Find collaborators on the OSC staff for various research and education projects, including major new grant-funded interdisciplinary initiatives.

## Software & Web Portals

### Software

Utilize a broad selection of applications, including more than 1,100 software packages that OSC staff update and test, as well as getting started guides.

### OSC OnDemand

Remotely use OSC's web-based portal, [ondemand.osc.edu](https://ondemand.osc.edu), from any device. Based on the OSC-developed Open OnDemand platform, supported by the National Science

Foundation, features include file management, command-line shell access, job management and monitoring across multiple batch servers and resource managers, and graphical desktop environments and applications. No software installation required.

### MyOSC

Manage your account through OSC’s client portal, [my.osc.edu](https://my.osc.edu). Clients can adjust passwords and contact information, manage project access, report funding and publications and run custom usage reports. The OSC team continually updates MyOSC to enhance the user experience.

## Hardware Services

### Cluster Computing

With flexible and scalable clusters rivaling those found at National Science Foundation centers and other national labs, OSC supercomputers provide a peak computing performance of 27.4 petaflops. OSC routinely upgrades its clusters to

ensure that researchers can access top-of-the-line supercomputing resources.

### Research Data Storage

Researchers can access upgraded storage services and a tape backup infrastructure capable of redundantly storing up to 23.5 PB of data. Protected Data Service (PDS) addresses the most common security control requirements encountered by researchers. Protected data types include International Traffic in Arms Regulations (ITAR), Export Administration Regulations (EAR), Health Insurance Portability and Accountability Act of 1996 (HIPAA), personally identifiable information (PII) and proprietary data.

### Globus Server

This free cloud-based service allows clients to move, share and discover research data through a single interface, regardless of its location or number of files or size. Globus is used extensively at supercomputer centers and major research facilities.



## SUPERCOMPUTERS

OSC’s supercomputers are the Pitzer cluster, whose namesake, Russell M. Pitzer, co-founded OSC and taught as a professor of chemistry at The Ohio State University; Ascend, which honors the state of Ohio’s long history of advancements in the aviation and aeronautics fields; and Cardinal, named for the state bird of Ohio.

| Compute                    | PITZER<br>2018 | PITZER<br>EXPANSION<br>2020 | ASCEND<br>2022, 2024 | CARDINAL<br>2024 | TOTALS         |
|----------------------------|----------------|-----------------------------|----------------------|------------------|----------------|
| Cost                       | \$3.4 million  | \$4.3 million               | \$10 million         | \$9.6 million    | \$27.3 million |
| Theoretical<br>Performance | ~1.3 PF        | ~2.6 PF                     | ~13 PF               | ~10.5 PF         | ~27.4 PF       |
| Nodes                      | 260            | 398                         | 274                  | 378              | 1,310          |
| CPU Cores                  | 10,560 Intel   | 19,104 Intel                | 32,112 AMD           | 39,312 Intel     | 101,088        |
| RAM                        | ~71 TB         | ~94 TB                      | ~161 TB              | ~281 TB          | ~607 TB        |
| GPUs                       | 64 NVIDIA      | 102 NVIDIA                  | 596 NVIDIA           | 128 NVIDIA       | 890            |

# ENGAGEMENT



## **Research Symposium**

Present your research findings and share information with others in the Ohio HPC community during this annual spring event.



## **Campus Champions**

Advocate for OSC's HPC resources at your academic institution and receive project accounts with no-cost access to a range of OSC services.



## **Community Briefing**

Join OSC leadership each fall to learn about major new initiatives; provide feedback about services, products and needs.



## **Client Continuity**

Inquire about opportunities to continue to use OSC resources at your next institution or private sector employer.



## **Social Media**

Follow our news and events on LinkedIn, Facebook or X and share your activities.

**[osc.edu/engagement](https://osc.edu/engagement)**

-  [x.com/osc](https://x.com/osc)
-  [facebook.com/ohiosupercomputercenter](https://facebook.com/ohiosupercomputercenter)
-  [linkedin.com/company/ohio-supercomputer-center](https://linkedin.com/company/ohio-supercomputer-center)
-  [osc.edu](https://osc.edu)

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**Department of  
Higher Education**  
Ohio Technology Consortium