Welcome to the 9th Annual NNCI Conference at University of Louisville

National Nanotechnology Coordinated Infrastructure

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Welcome and Thank You

Welcome

- External Advisory Board Members
- NNCI Site Leadership and Staff
- NSF Program Directors
- NNCO Leadership
- DOE NSRC Leadership
- Guests

Thank You

- KY Multiscale and University of Louisville
- NNCI Coordinating Office Staff
- NSF

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NNCI Advisory Board

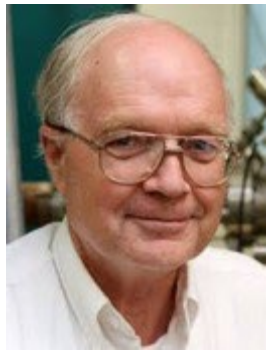
Andrew Greenberg
U Wisconsin

Elaine Cohen Hubal
EPA

Angelique Johnson
Entrepreneur

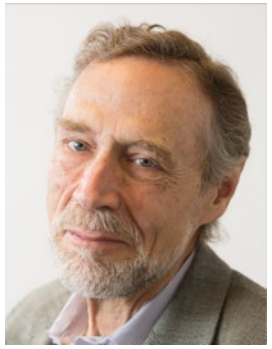
Joe Magno
NIIT

Ambika Bumb
Bipartisan Commission on Biodefense



Richard Osgood
Columbia U

Kurt Petersen
Entrepreneur



Tom Theis
Utopus Insights

Ken Wise
U Michigan

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NNCI Coordinating Office

Amy Duke
Program Manager
Georgia Tech

Matt Hull
AD Innovation & Entrepreneurship
Virginia Tech

Azad Naeemi
AD Computation
Georgia Tech

Mikkel Thomas
AD Education & Outreach
Georgia Tech

Jamey Wetmore
AD Societal & Ethical Implications
Arizona State Univ.

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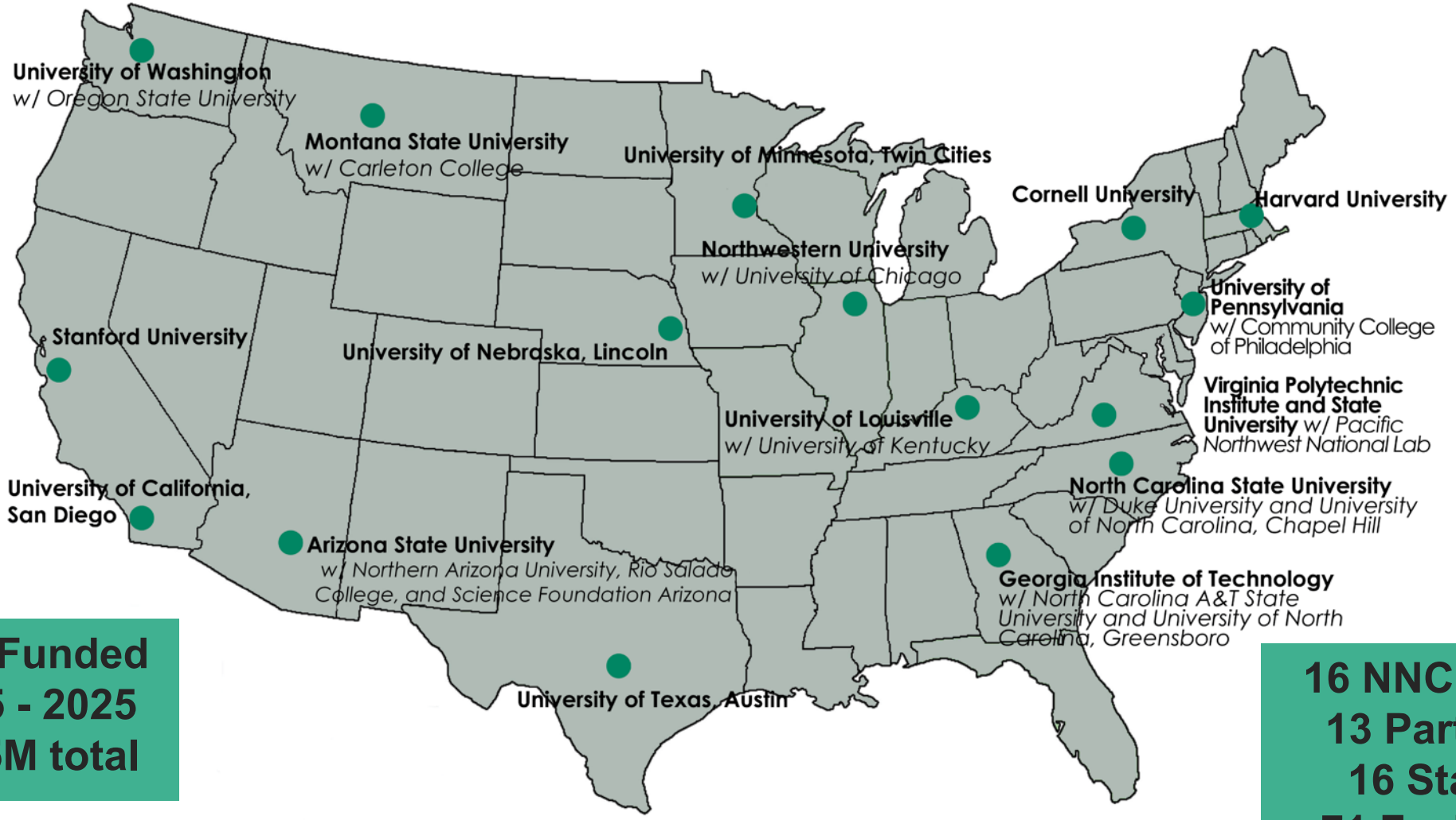
AD Reports: 10:45-11:45AM TODAY

NNCI Network



NSF Funded
2015 - 2025
$165M total

16 NNCI Sites
13 Partners
16 States
71 Facilities
>2,200 Tools

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NNCI Goals

- Provide open access to **state-of-the-art nano-fabrication & characterization facilities** and their tools across the US and **staff expertise**
- Use these resources to support **education & outreach (E&O), societal & ethical implications (SEI),** and **innovation and entrepreneurship** in/of nanotechnology.
- **Network approach to make whole more than the sum of its parts**

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NNCI Coordinating Office – What We Do

- Organization of monthly site director meetings
- Creation of subcommittees and working groups
- Organization of research communities
- Creation and maintenance of the NNCI website
- Organization of the NNCI Annual Conference and REU Convocation
- Interfacing with NSF and the External Advisory Board
- Coordination of the NNCI webinar series and YouTube channel
- Facilitating interactions among the sites via an email listserv
- Incentivizing sites to collaborate via support of workshops
- Marketing the NNCI at conferences and trade shows and through printed and electronic materials
- Development and implementation of an annual user satisfaction survey
- Management of the Outstanding NNCI Staff Member awards
- Providing unified outlines and templates for site reports, reverse site reviews, and annual conference
- Collection of site usage statistics and other impact metrics
- Collection of annual user highlights
- Preparation of the annual report

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NNCI Coordinating Office – What We Don't Do

- Uniform user proposal or application process
- Uniform site usage procedures, policies, training, and rates
- Coordinate purchasing of new tools
- Approve and allocate site budgets
- Direct site programs and activities

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NNCI Coordinating Office Activity

- *Society for Social Studies of Science Annual Meeting,* Nov. 9-10, 2023
- "Report to the National Science Foundation on *The Workshop on Nanotechnology Infrastructure of the Future*," November 2023
- *Celebrating the 20th Anniversary of the 21st Century Nanotechnology Research and Development Act*, March 5, 2024
- NASEM Quadrennial Review of the NNI, June-Sept. 2024
- Visit of South Korean delegation from KAIST and KION, July 19, 2024
- *nanoFabUK Symposium*, Sept. 3-5, 2024
- NSF Award "Experiential Learning for Semiconductor Physics and Devices", Georgia Tech, ASU, UW, Purdue, KSU, and Hampton University
- NSF Award "Research Experiences for Teachers across the National Nanotechnology Coordinated Infrastructure", Georgia Tech, Univ. Minnesota, and Univ. Nebraska-Lincoln

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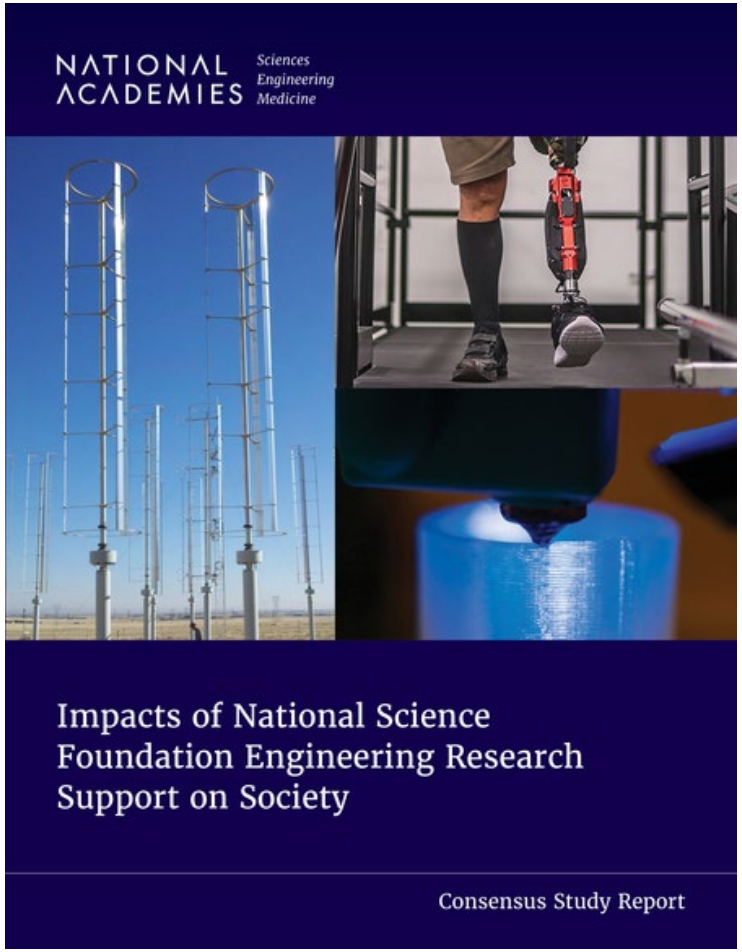
Why do we collect data and metrics?

1. Funding agencies want to see how the money is spent.
2. Universities use the data to allocate resources.
3. Facility managers use data to refine capabilities and understand userbase trends.
4. Researchers want to see the impact of their work.

NNCI metrics:

- ability to serve the greatest number and most diverse set of researchers from academia, industry, and government
- impact on the research enterprise and its economic importance
- societal impact based on improved public awareness, diversity, and workforce development
- success of the network/consortium model



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NNCI User Statistics Year 8 (Oct. 2022 – Sept. 2023)

	Year 8 Total	Site Mean (Min – *Median* – Max)
Unique Facility Users	**13,722**	**858** (250 – *728* – 1,781)
Unique Ext. Users	**3,643** **26.6%**	**228** (67 – *198* – 579) **26.8%** (14.2% – *25.8%* – 50.1%)
Industry Users	**2,044**	**128** (23 – *94* – 376)
Acad., Gov., For. Users	**1,599**	**100** (16 – *102* – 314)
Avg Monthly Users	**5,296**	**331** (68 – *268* – 815)
New Users Trained	**5,115**	**320** (12 – *256* –754)
Facility Hours	**1,095,931**	**68,496** (9,548 – *55,652* – 200,070)
Ext. Facilities Hours	**256,767** **23.4%**	**16,048** (1,667 – *12,226* – 66,198) **22.8%** (7.4% – *18.0%* – 49.1%)
Hours/User	**80**	**75** (33 – *72* – 144)
Total User Fees	**$45.7M**	**$2.86M** ($291k – *$2.87M* – $6.71M)
$/Hour	**$42**	**$44** ($18 – *$44* – $77)

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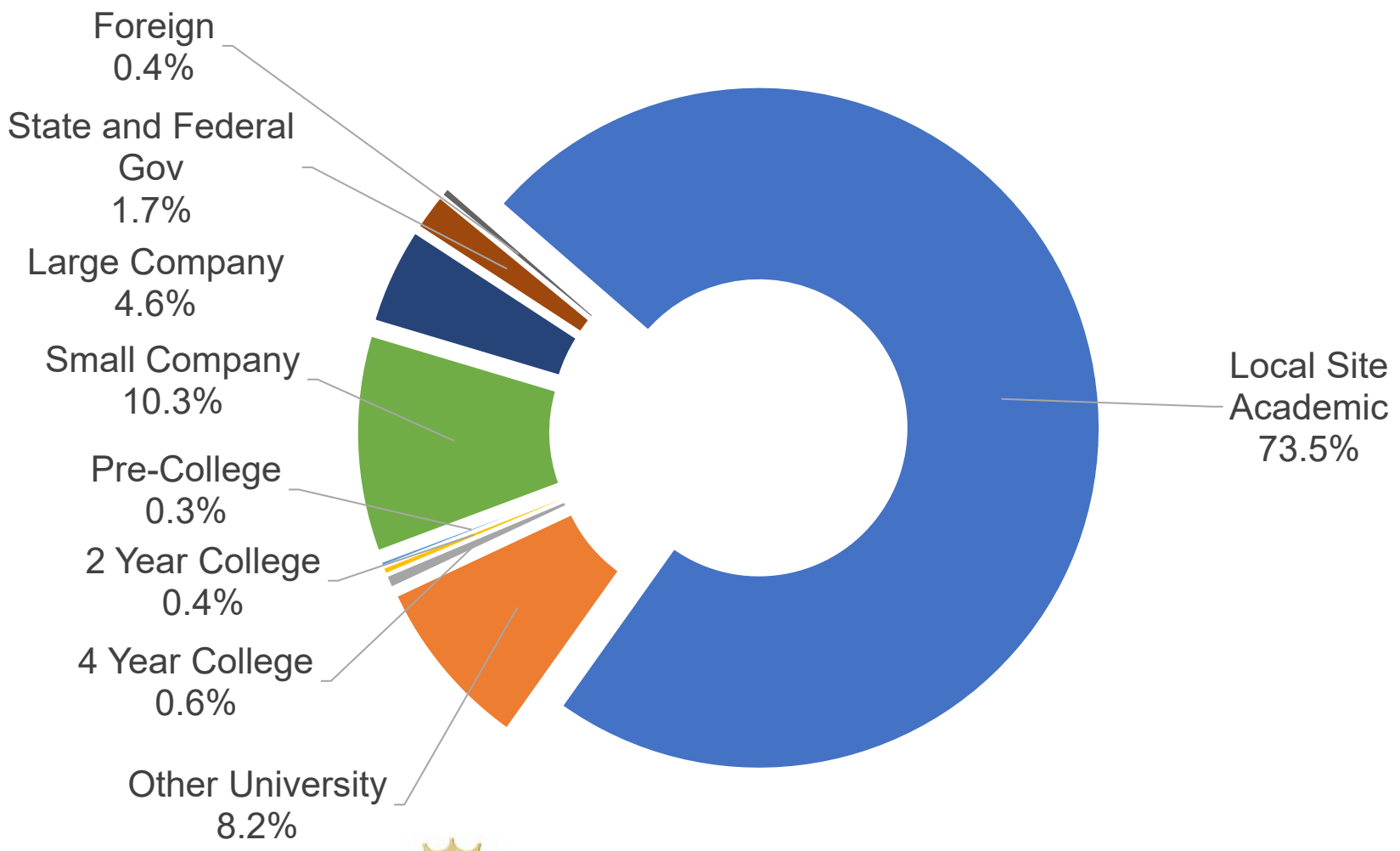
NNCI Users by Affiliation – Year 8



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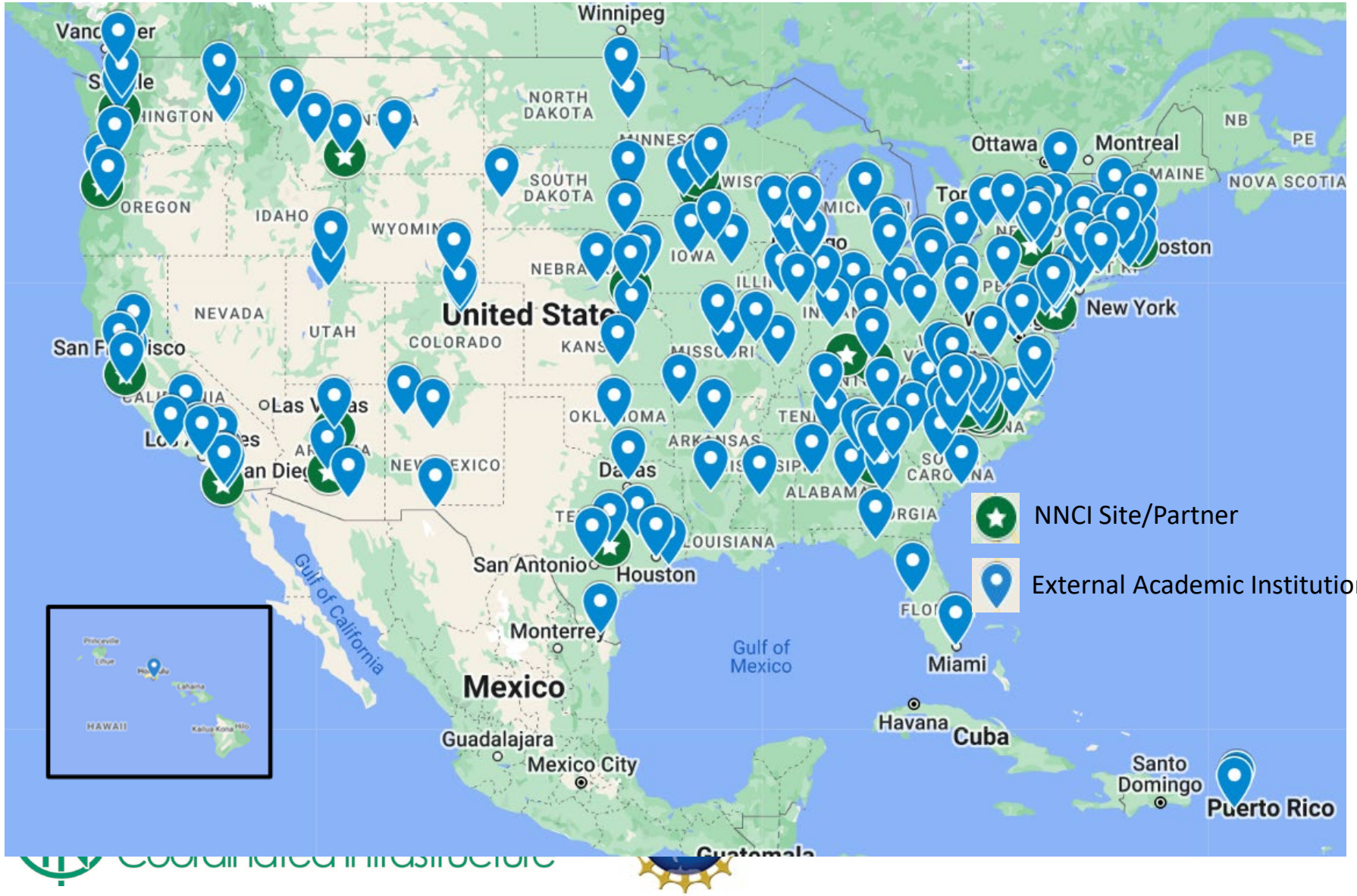
NNCI Year 8 US Academic Institutions



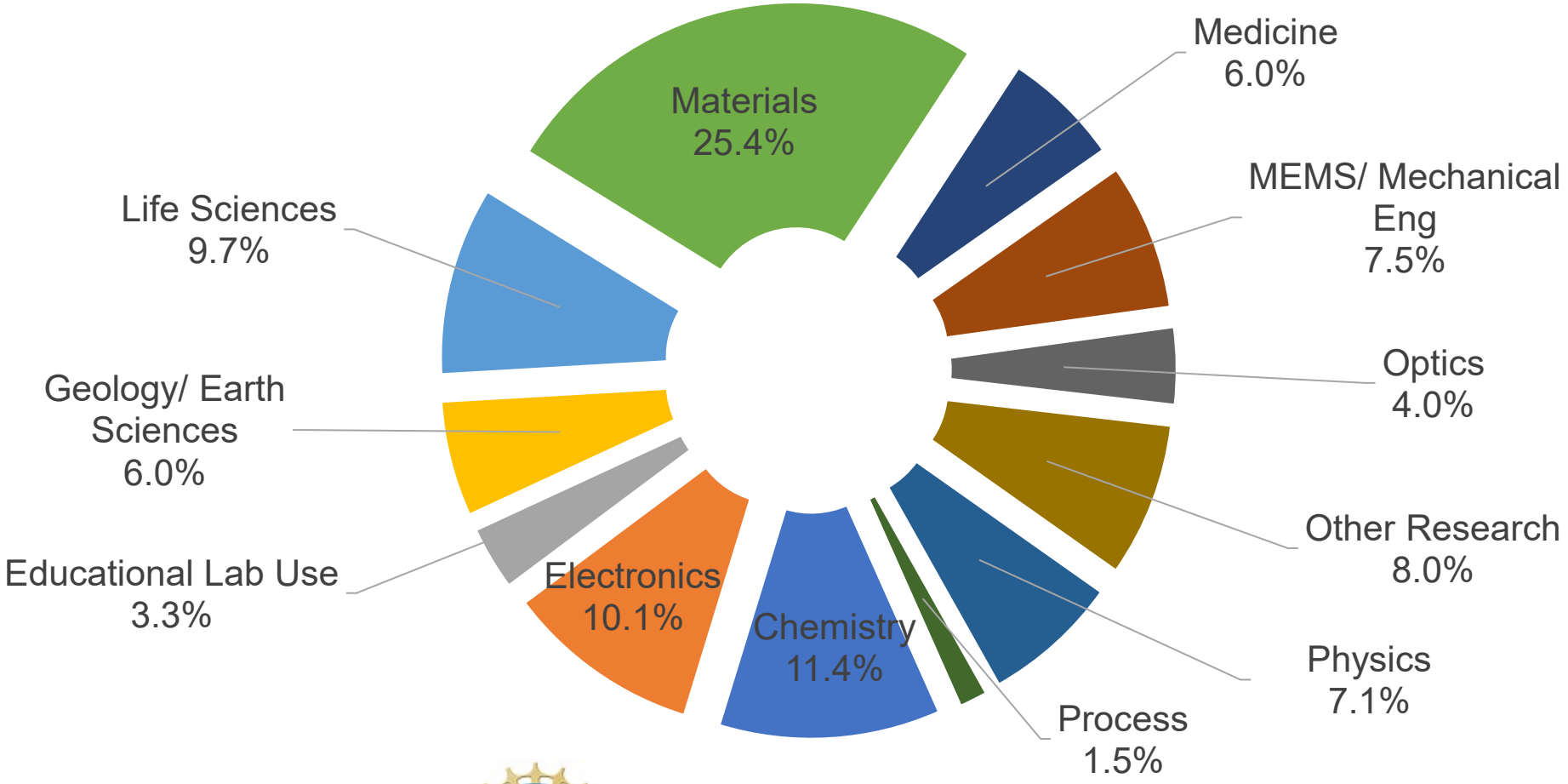
222 US academic institutions, including:

- **25 HSI, 25 EHSI**
- **13 HBCU, 2 PBI**
- **23 AANAPISI**
- **1 TCU**
- **1 ANNH**

In addition:

- **594 small companies**
- **199 large companies**
- **25 government**
- **37 international**
- **22 other**

NNCI Users by Discipline – Year 8



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NNCI User Statistics Year 1 – Year 8

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Unique Facility Users	10,909	12,452	13,110	13,355	10,501	11,242	13,348	**13,722**
Unique Ext. Users	2,567 23.5%	3,176 25.5%	3,379 25.8%	**3,852** 28.8%	2,833 27.0%	2,793 24.8%	3,381 25.3%	3,643 26.6%
Industry Users	1,413	1,669	1,870	1,961	1,529	1,619	1,882	**2,044**
Ext. Academic Users	1,060	1,295	1,365	**1,531**	1,064	964	1,238	1,300
Avg Monthly Users	4,429	4,911	5,001	5,292	3,654	4,381	5,112	**5,296**
New Users Trained	4,116	4,563	4,981	**5,194**	2,813	4,414	5,151	5,115
Facility Hours	909,151	939,230	1,006,764	**1,149,788**	767,255	967,297	1,072,332	1,095,931
Ext. Facilities Hours	173,511 19.1%	191,494 20.4%	228,441 22.7%	**298,986** 26.0%	197,368 25.7%	242,926 25.1%	253,667 23.7%	256,767 23.4%
Hours/User	83	75	77	**86**	73	86	80	80
Total User Fees	$34.3M	$37.5M	$40.5M	$43.7M	$29.4M	$39.7M	$44.5M	**$45.7M**
$/Hour	$38	$40	$40	$38	$38	$41	$42	$42

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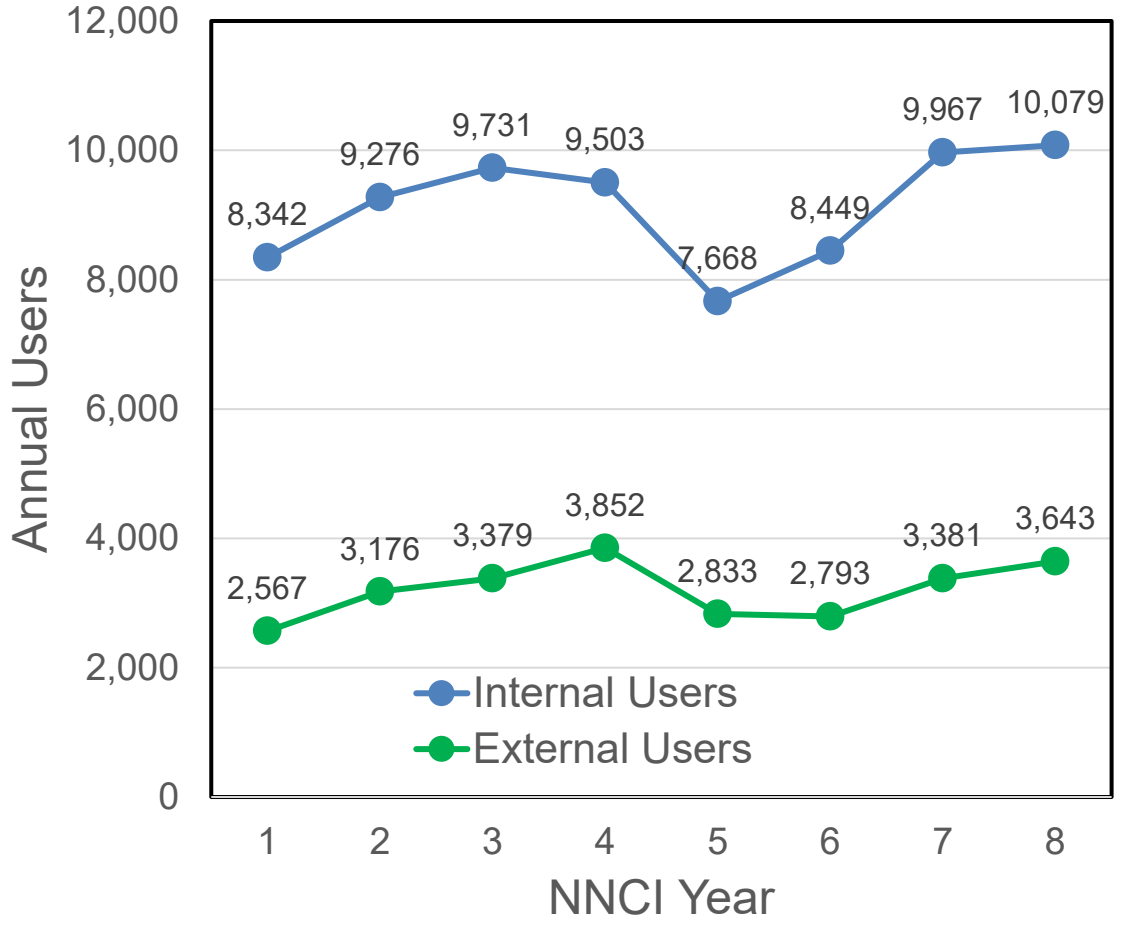
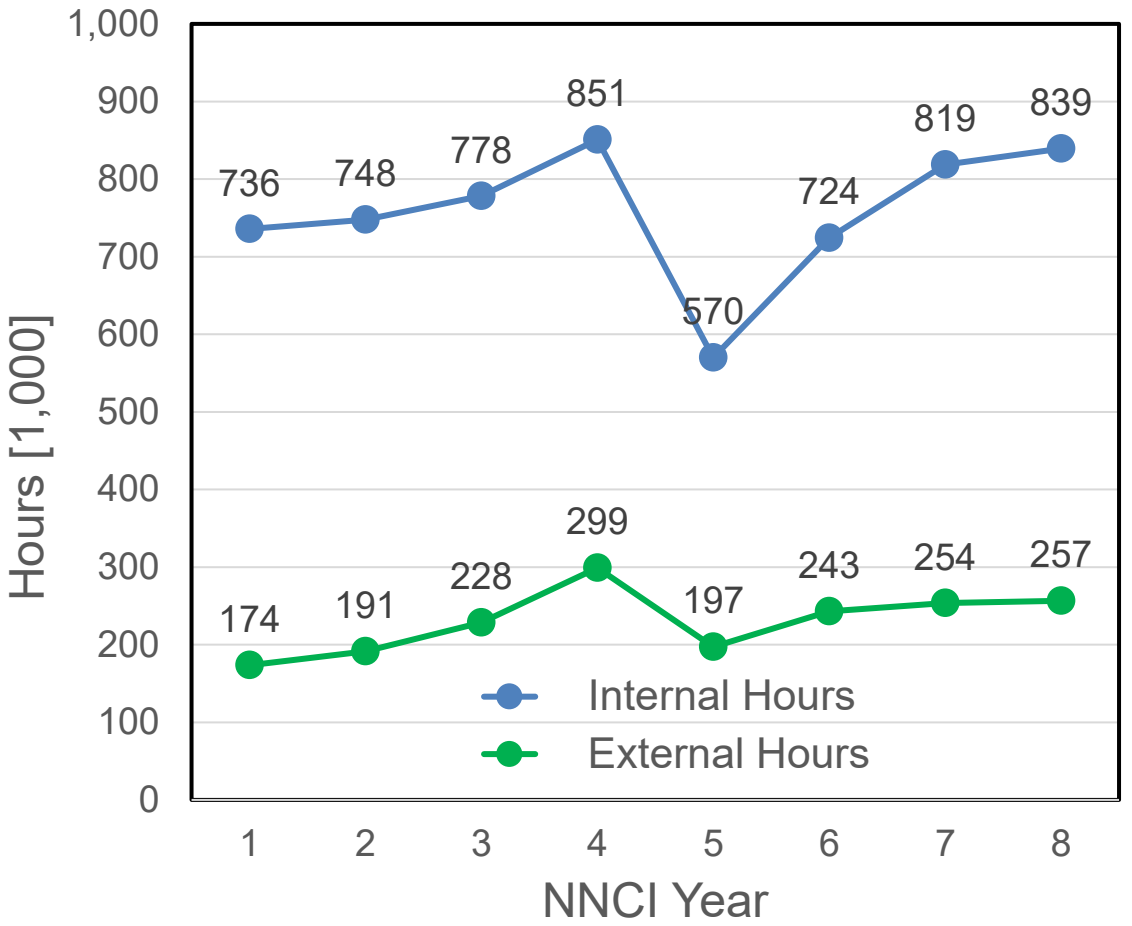
Year 8: October 2022 - September 2023

NNCI Users & Hours: Years 1-8





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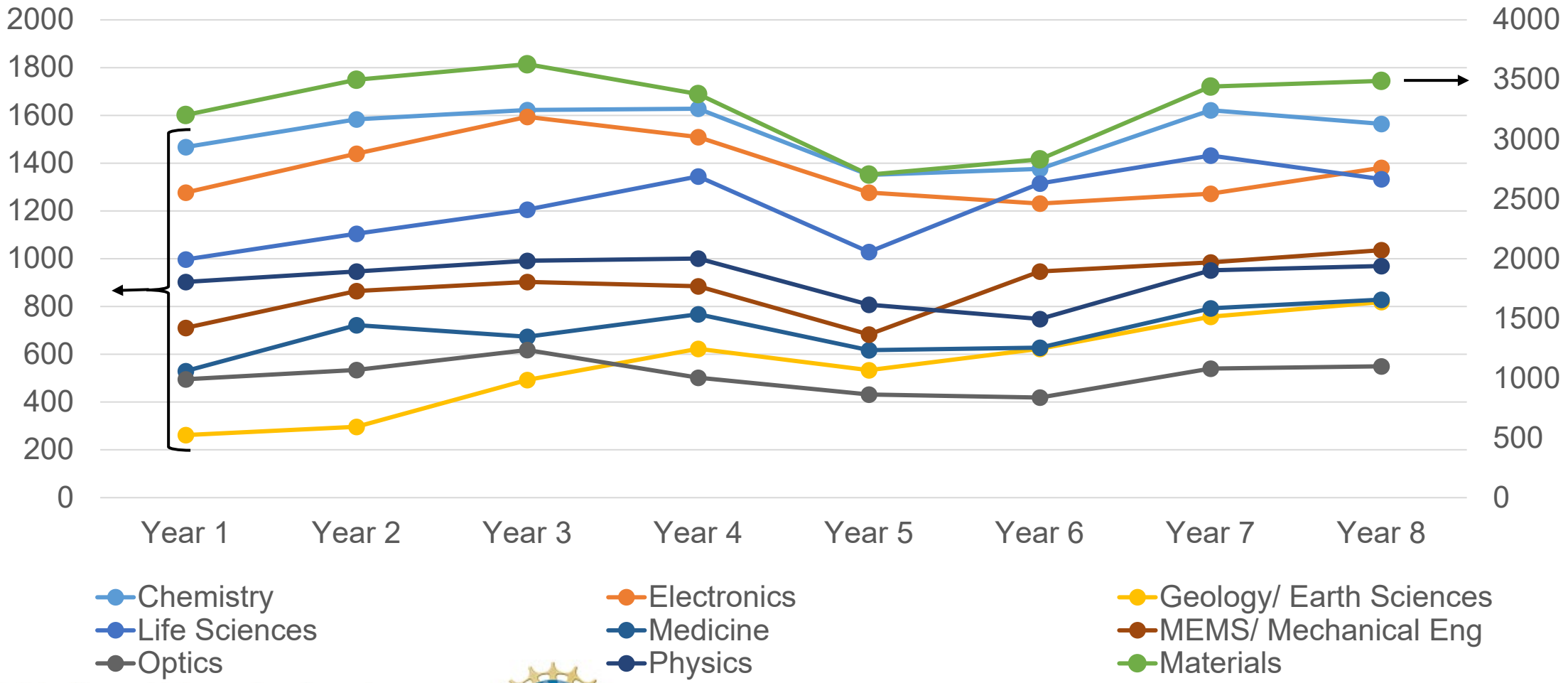
NNCI Users by Discipline – Years 1-8



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NNCI User Metrics (Years 1-8)

- Total Unique Users: >43,000
  - 4,760 average monthly users
  - 5,000 new users trained/year
- Usage Hours: ~8 million
- External Users: >10,800 (25%)
  - 4,500 academic
  - 5,500 industry
  - 700 government/foreign
- User Institutions:
  - 445 US academic institutions
  - 2,700 small and large companies
  - 200 foreign institutions (50 countries, 67% academic)

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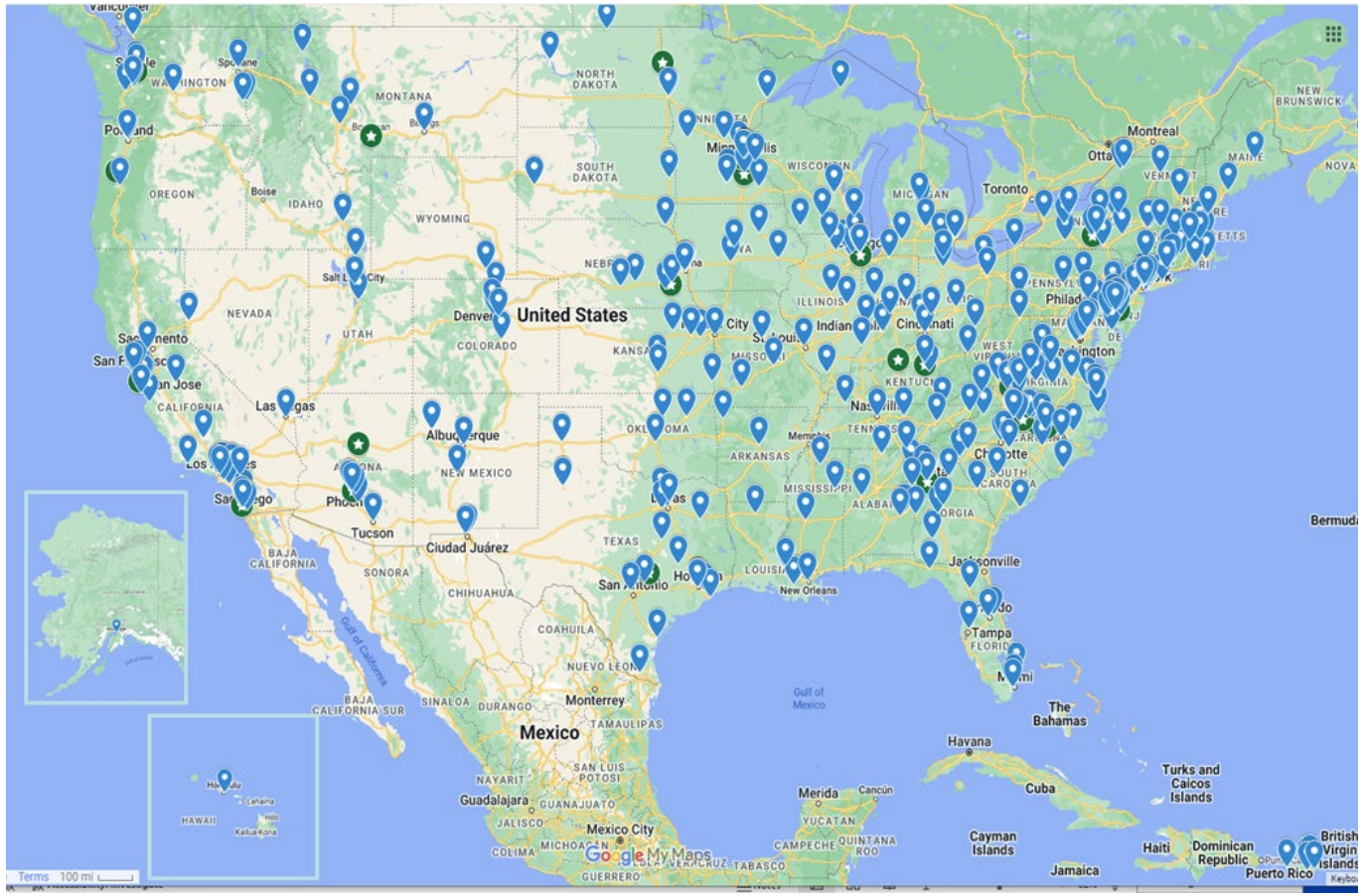
NNCI US Academic Institutions



131 Minority Serving Institutions (29%), including 20 HBCUs and 52 HSIs
215 R1/R2 institutions; 230 non-R1/R2 institutions

NNCI Years 5-9: 6-Month Data Comparison

	Year 5 6 months	Year 6 6 months	Year 7 6 months	Year 8 6 months	Year 9 6 months
Unique Facility Users	9,328	7,535	9,208	10,279	**10,711**
Unique External Users	2,451 / 26.3%	1,764 / 23.4%	2,157 / 23.4%	2,401 / 23.4%	**2,546 / 23.8%**
Industry Users	1,297	1,073	1,244	1,472	1,471
Ext. Academic Users	937	533	730	755	**871**
Other External Users	217	158	183	174	**204**
Average Monthly Users	4,999	4,037	4,766	5,264	**5,552**
New Users Trained	2,130	1,762	2,435	2,392	**2,642**
Facility Hours	505,830	440,011	517,130	526,181	**562,980**
Ext. Facilities Hours	128,856 / 25.5%	110,978 / 25.2%	122,076 / 23.6%	118,431 / 22.5%	**125,373** / 22.3%
Hours/User	54	58	56	51	53
Total User Fees	$19.0M	$18.1M	$21.5M	$22.1M	**$24.0M**

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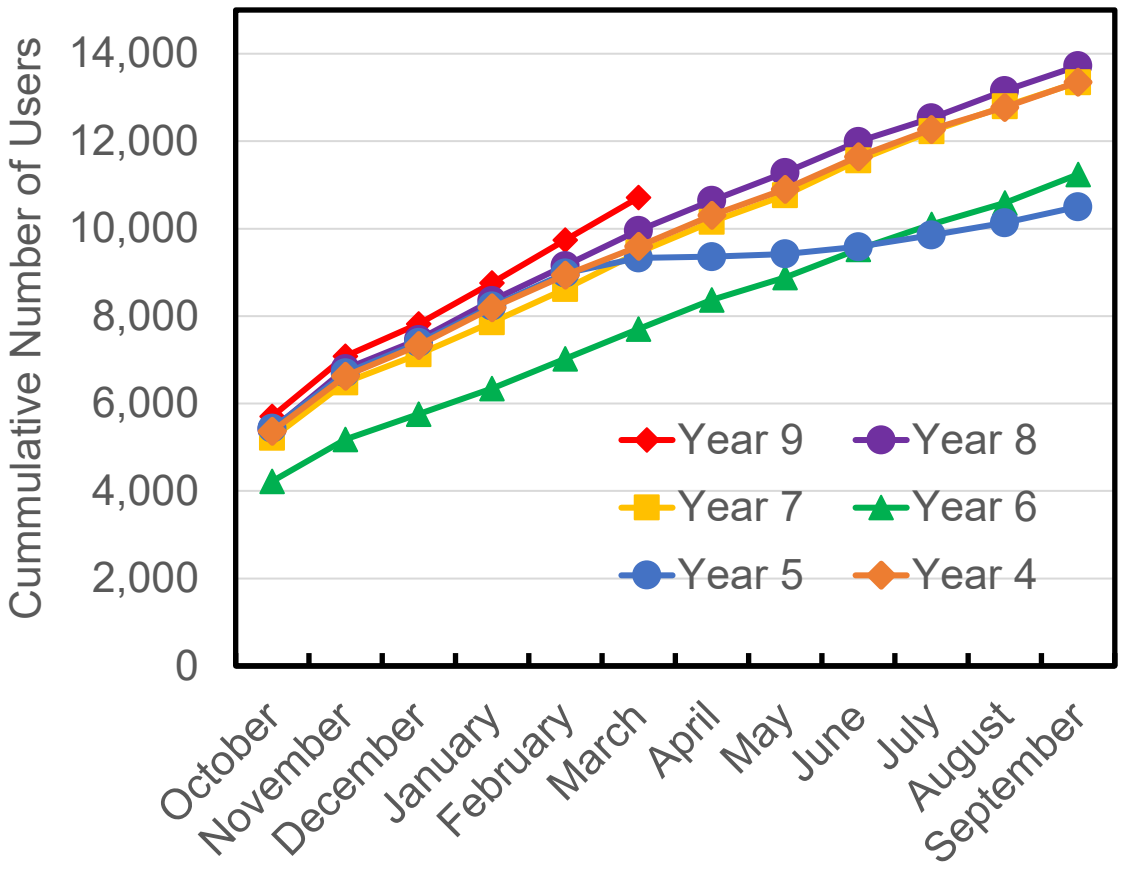
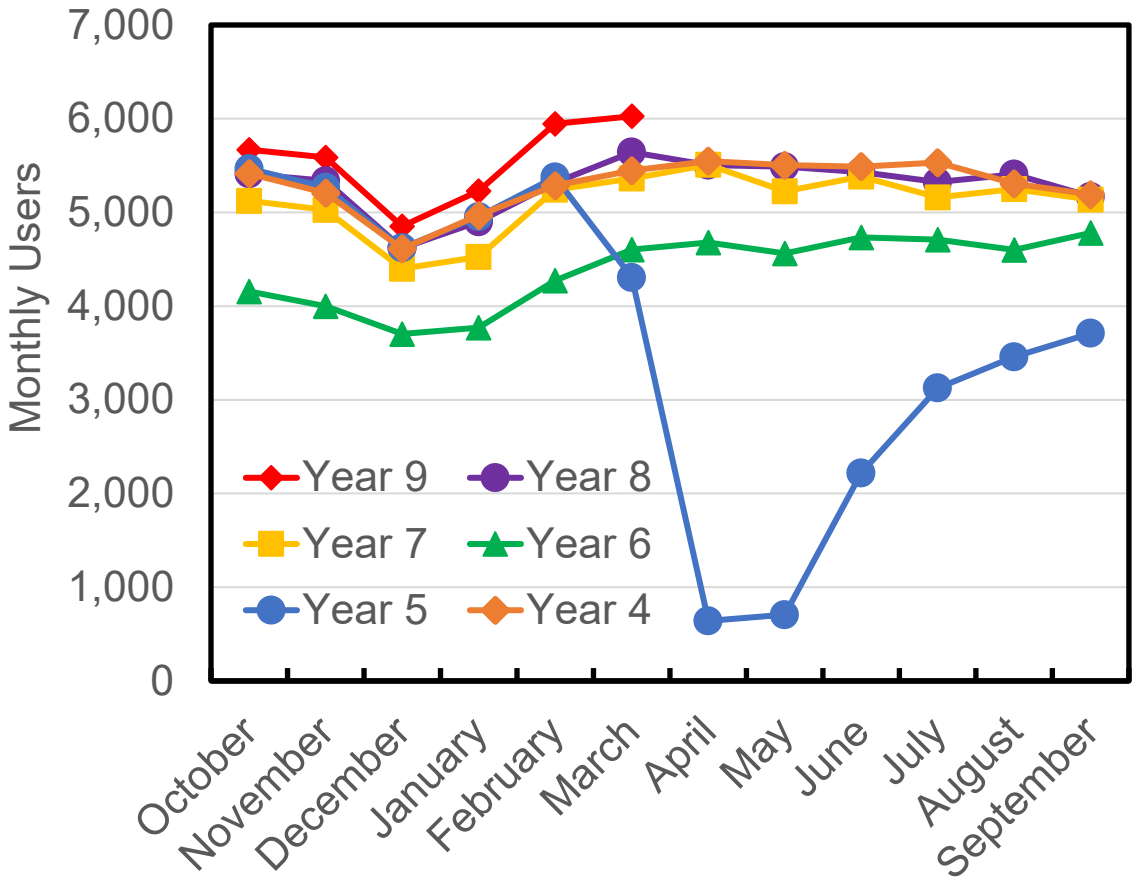
Year 9: October 2023 - March 2024

NNCI Users: Years 4-9





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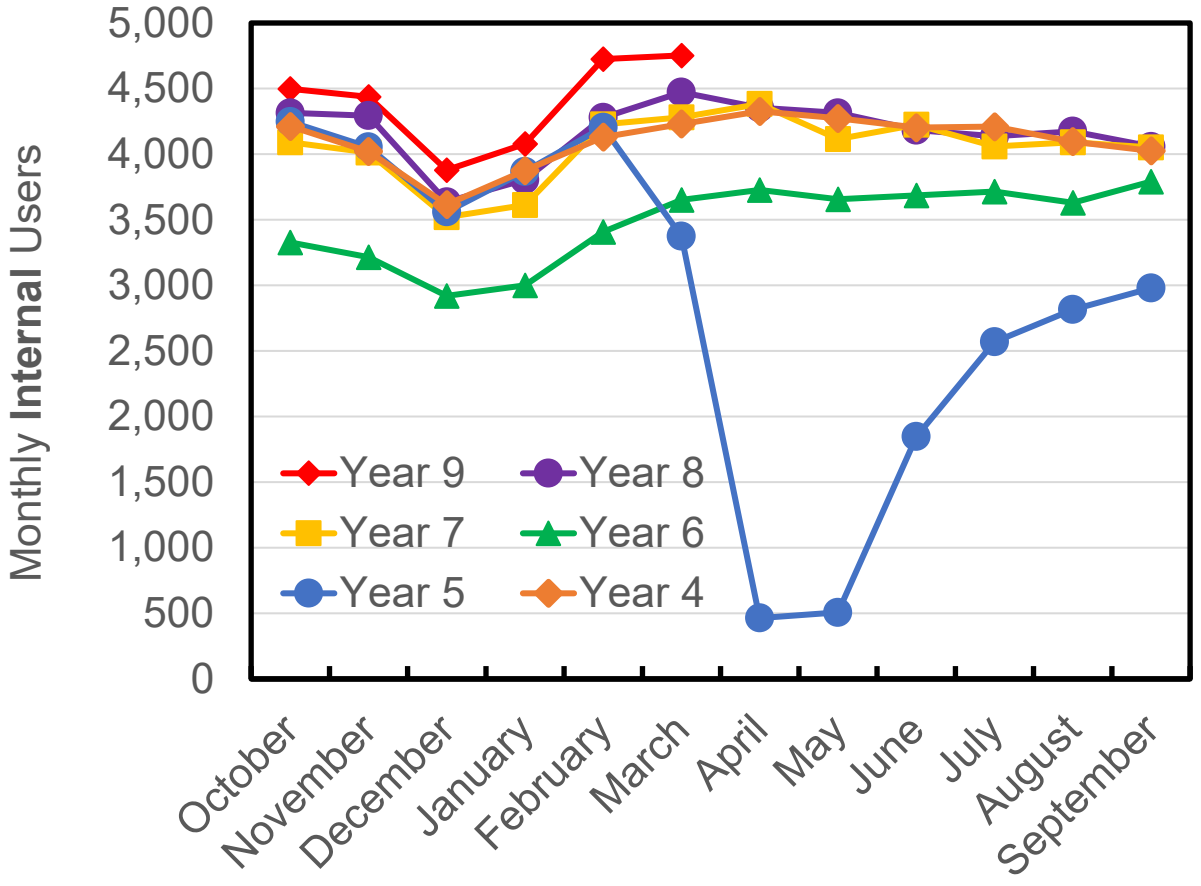
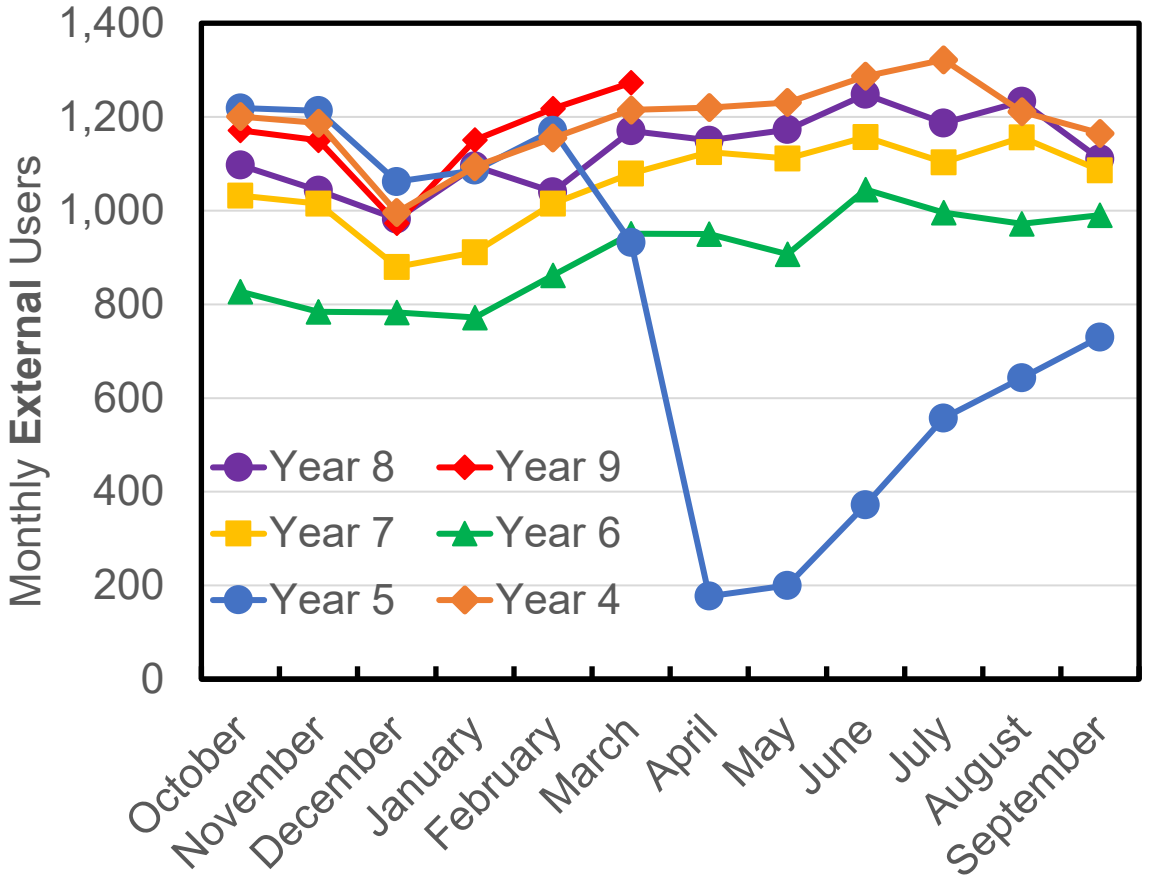
NNCI Internal vs. External Users: Years 4-9





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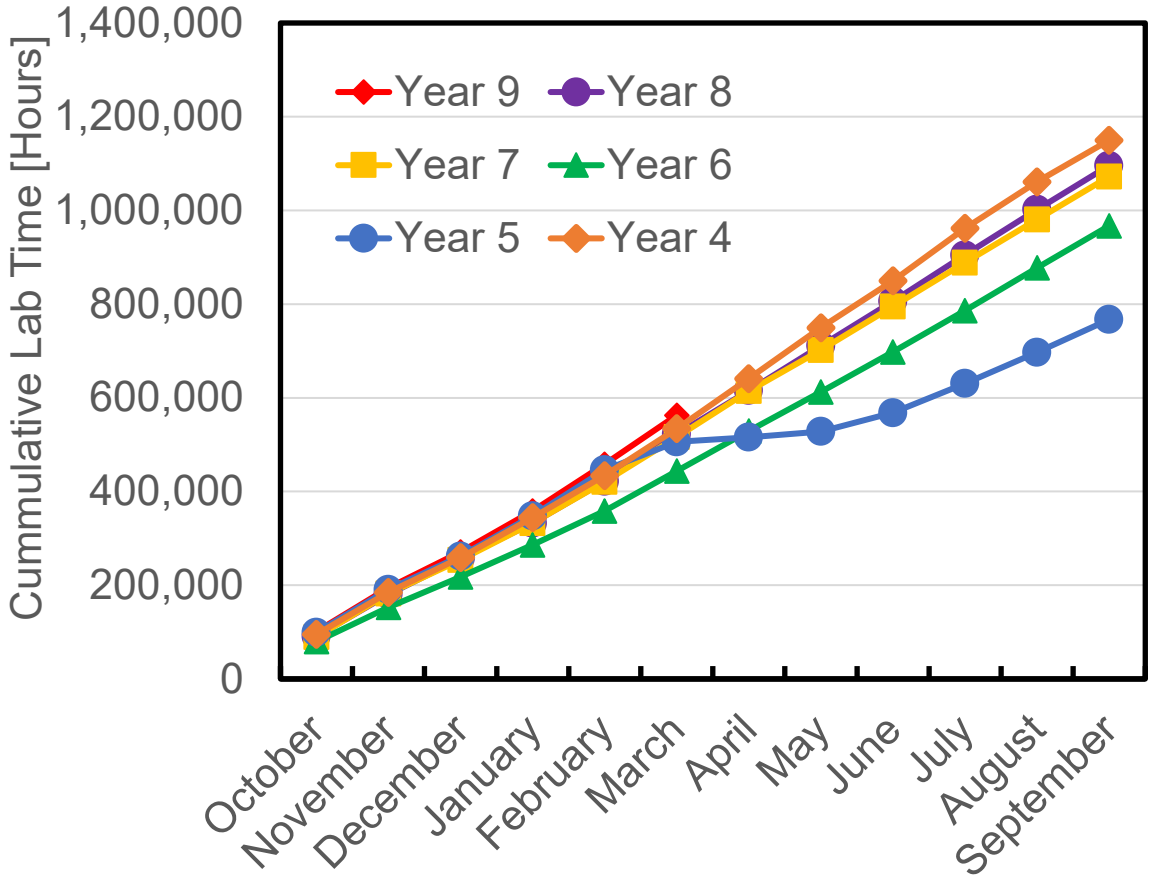
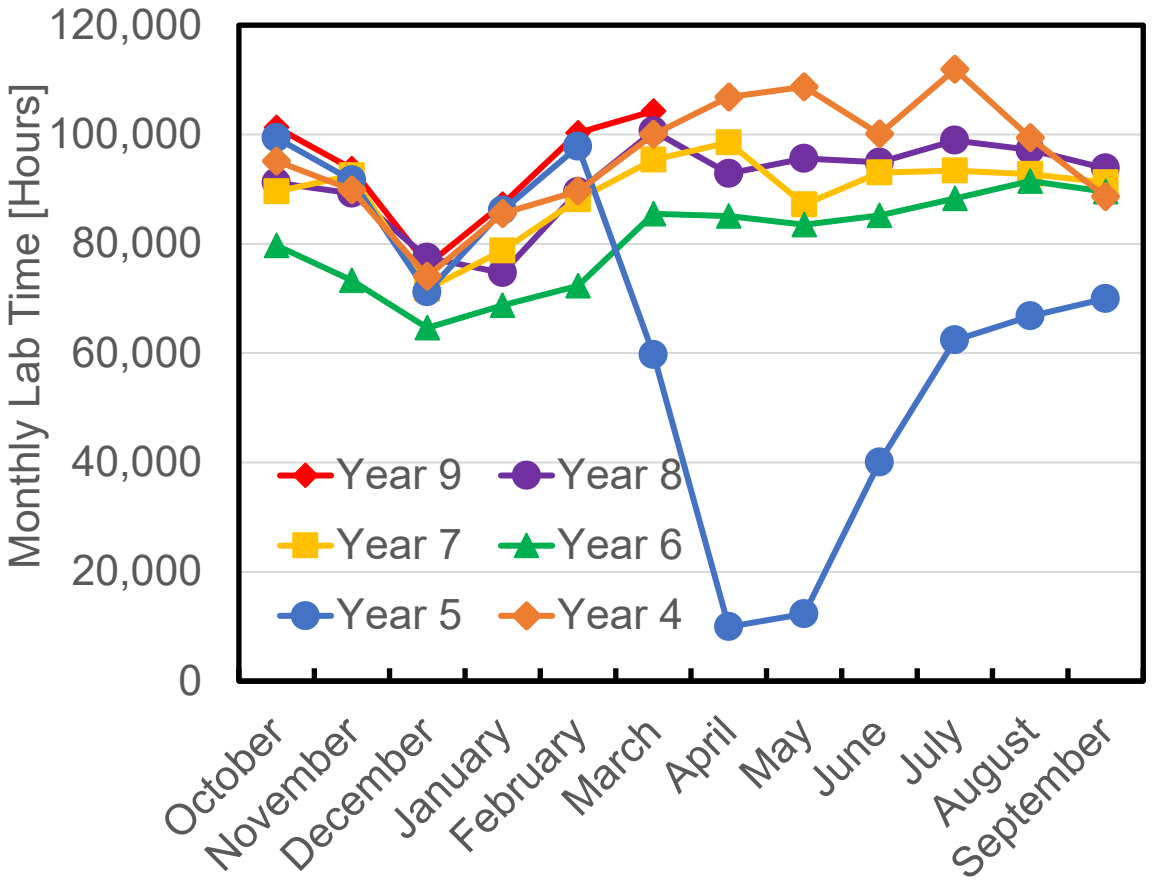
NNCI Lab Time: Years 4-9





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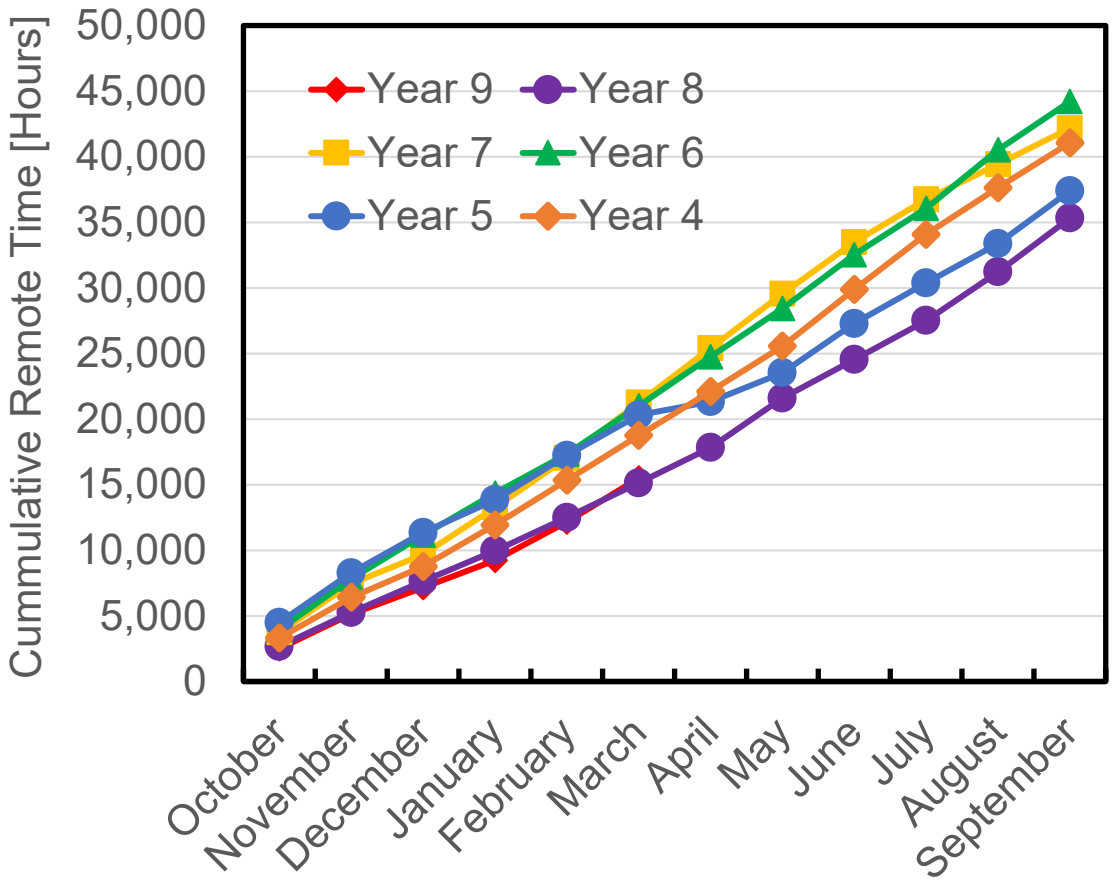
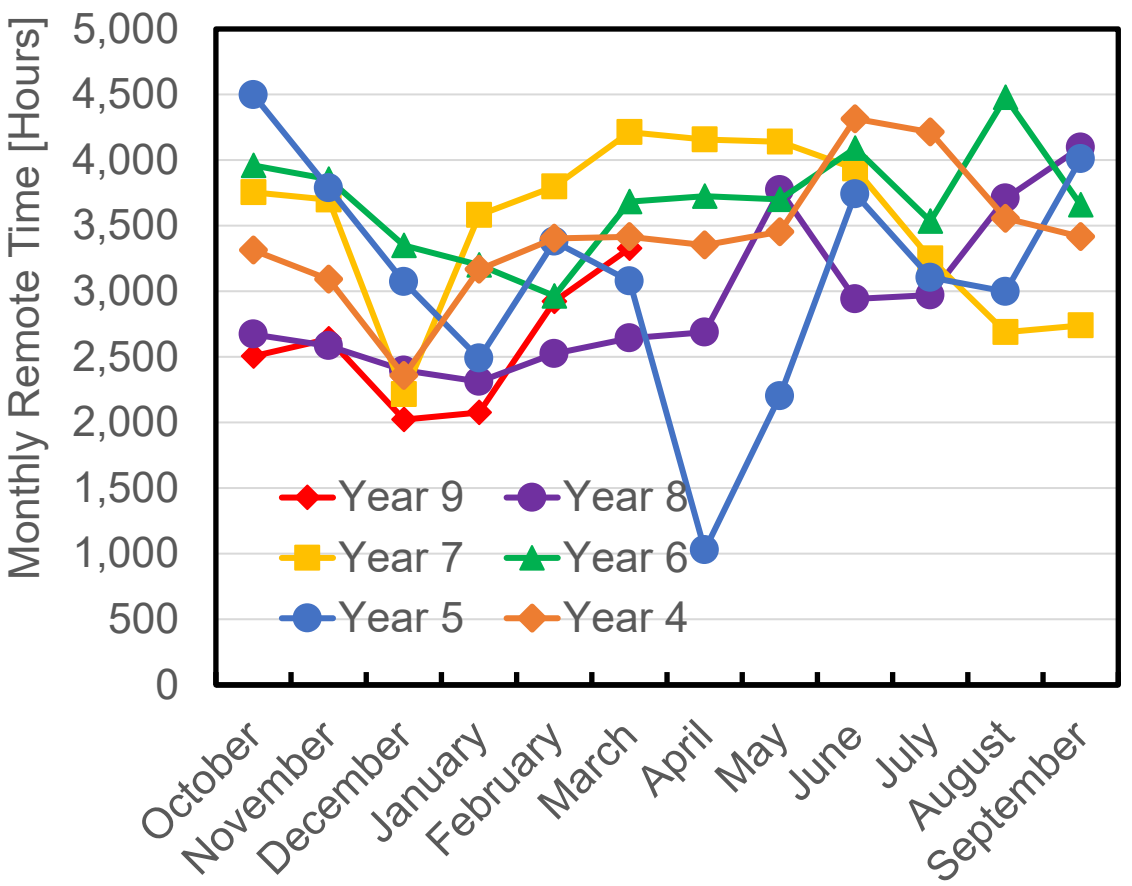
NNCI Remote Work: Years 4-9





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NNCI Impact

- Scholarly Impact - Publications
  - NSF award citations
- Degrees Granted to NNCI Users
- Courses Supported
- Major Centers Supported
- Research Funding Supported by NNCI (last year)

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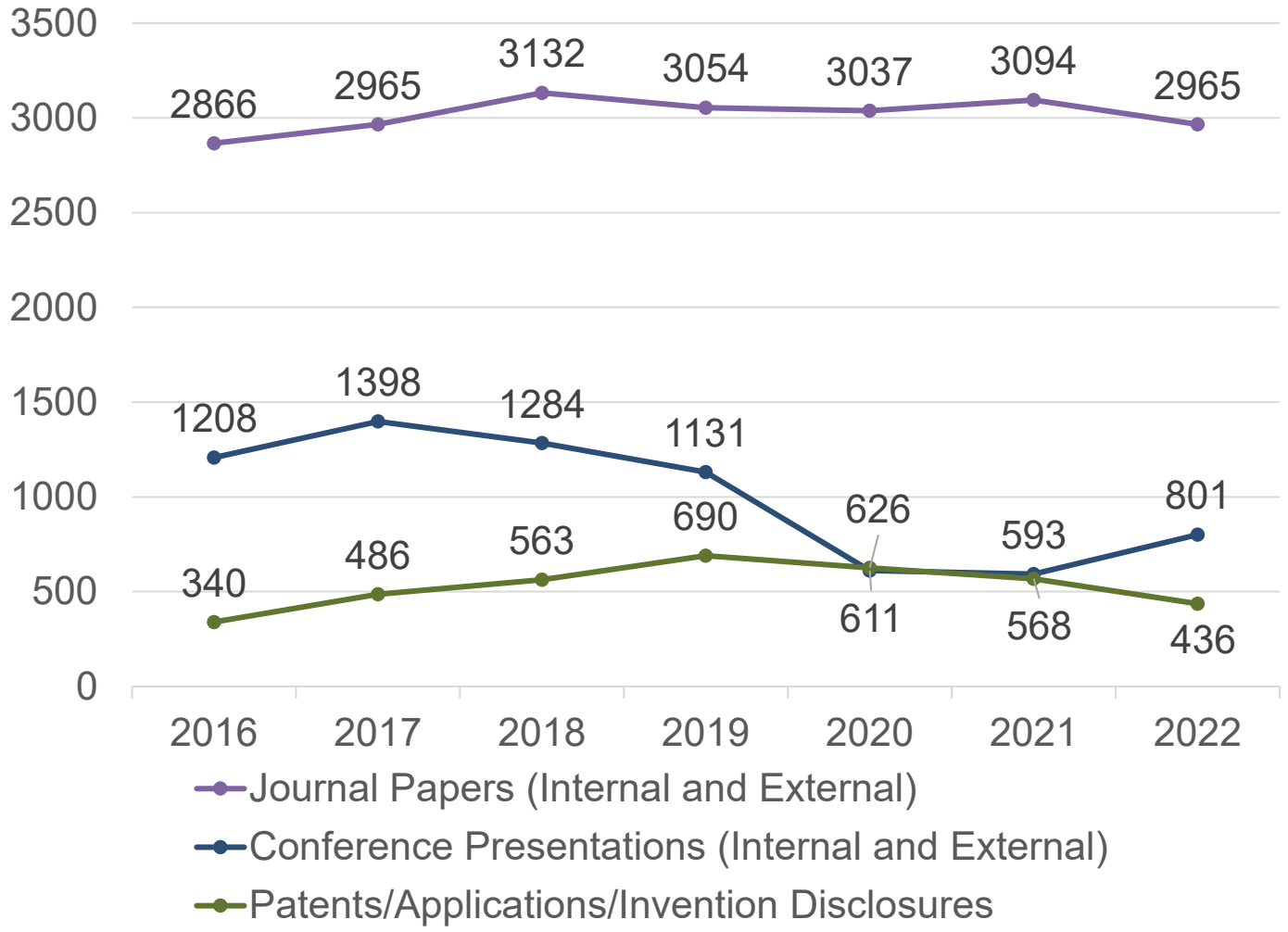
NNCI Impact – Publications CY 2016-2022

Total Publications (2016-2022)

- >21,000 journal publications (11.5% external users)
- >7,000 conference presentations (9.2% external users)
- >200 books/book chapters
- >3,700 patents/patent applications/invention disclosures



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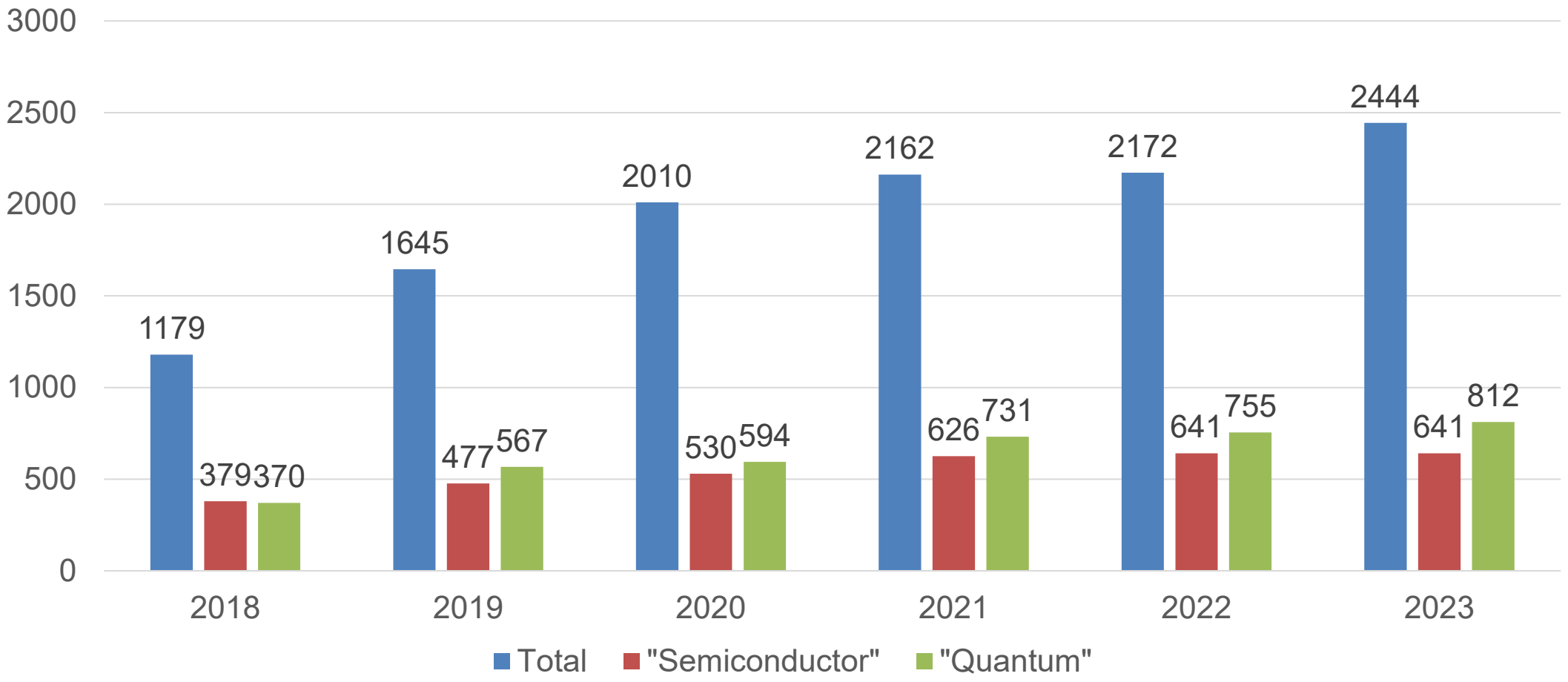
NNCI Impact – Journal Publications with Acknowledgement



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Google Scholar search for NNCI NSF award numbers (through 01/12/2024)

NNCI Impact – Degrees Granted to Users
Fall 2022 – Summer 2023 (14 Sites)

Academic Department	BS*	MS*	PhD	Other	Total
Aerospace Engineering	5	5	5	0	15
Biomedical Engineering	22	35	37	1	95
Chemical Engineering	26	38	63	2	129
Civil and Environmental Engineering	1	12	27	0	40
Electrical and Computer Engineering	32	163	77	5	277
Industrial Engineering	0	0	1	0	1
Materials Science and Engineering	45	142	115	0	302
Mechanical Engineering	26	64	67	1	158
Nanoengineering	0	16	16	5	37
Nuclear Engineering	0	5	7	0	12
Biology	9	7	13	2	31
Chemistry and Biochemistry	28	30	133	1	192
Earth and Atmospheric Sciences	3	4	6	0	13
Physics	24	23	62	0	109
Nanoscience	8	5	10	0	23
Computer Science	3	14	2	0	19
Medical School	7	5	12	4	28
Veterinary School	0	0	1	0	1
Other	18	10	17	21	66
Total	**257**	**578**	**671**	**42**	**1548**

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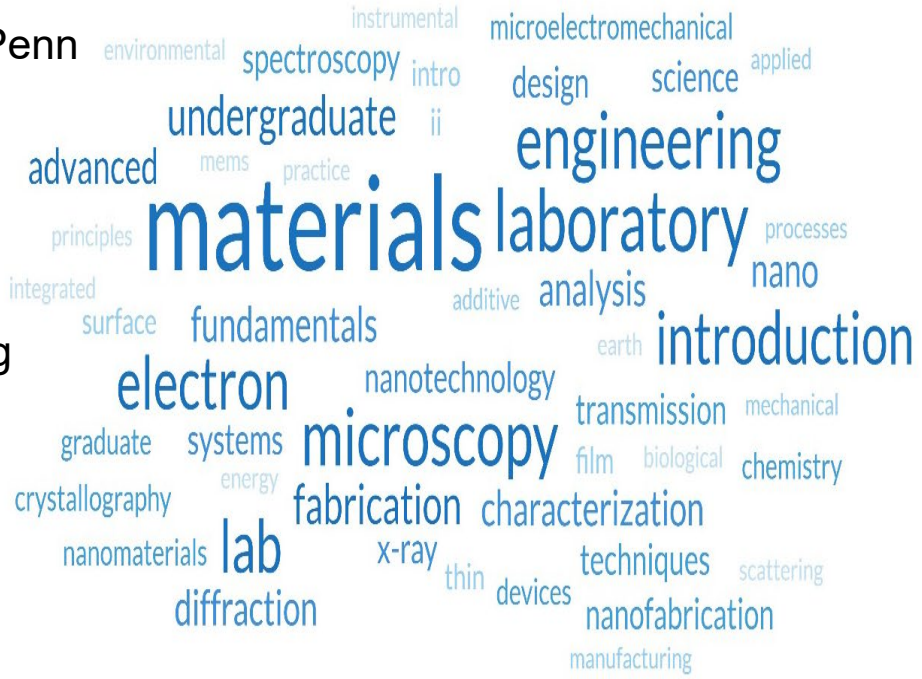
Numbers are lower bound!

By Site: Mean=110, Range=20-284

NNCI Impact – Courses Supported
Fall 2022 – Summer 2023 (16 Sites)

- More than **130 individual courses** were supported from **28 different academic departments**.
- Total course enrollment of **3,609 students** (site range: 25-1,525).

Bioengineering
Biological Mechanical Engineering
Biology
Biomedical Engineering
Biotechnology Program
Chemical and Biomolecular Engineering
Chemical Engineering
Chemistry
Chemistry & Biochemistry
Civil and Environmental Engineering
Earth and Planetary Sciences
Education
Electrical and Computer Engineering
Electrical and Systems Engineering
Electrical Engineering
Engineering
Engineering and Applied Sciences
Engineering Summer Academy at Penn
Fiber Science
Industrial Engineering
Macromolecular Science and Engineering
Materials Science
Materials Sciences and Engineering
Mechanical Engineering
Nanoengineering
Nanoscience
Physics
Sustainability



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NNCI Impact – New Research Centers

70 Reported in Years 5-7:

- NSF: 14 ERC, 6 STC, 7 MRSEC, 2 MIP, IUCRC, 2 NRT
- DOE: 6 EFRC, Industrial Assessment Center, Energy Innovation Hub
- 5 NIH, 1 SRC, 1 NIST, 3 DoD

18 *New* in Year 8:

- NSF: 2 FUSE, 2 RIE Development
- DoD: 8 ME Commons Hubs
- SRC: 3 JUMP 2.0

CoCoSys
CENTER FOR THE CO-DESIGN OF COGNITIVE SYSTEMS

SUPREME
SUPeRior Energy-efficient Materials and dEvices

NORDTECH
Northeast Regional Defense Technology Hub

CLAWS
Commercial Leap Ahead for Wide Bandgap Semiconductors

DREAMS
Defense Ready Electronics and Microdevices Superhub

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NNCI Programs

- Subcommittees & Working Groups
- Research Communities
- Regional Networks
- NNCI Webinars/YouTube Channel
- NNCI User Survey
- Education and Workforce Development
- Societal and Ethical Implications Programs
- Innovation and Entrepreneurship Programs
- Computation Activities

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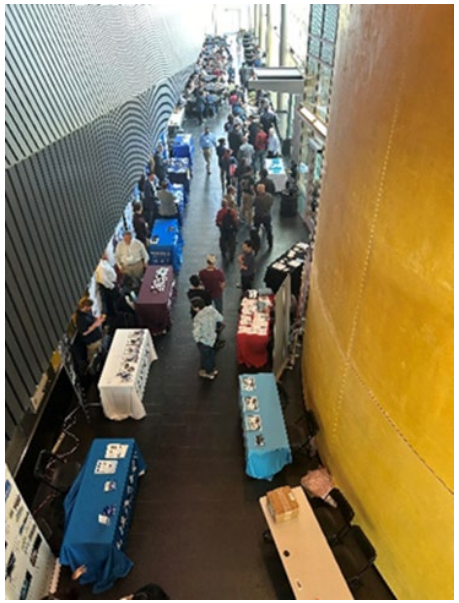
NNCI Network Collaborative Activities

- 15 Working Groups with >200 staff participants
  - 18 workshops organized since 2016
- 6 Research Communities
  - 11 workshops organized since 2021
- 8 Regional Networks
  - 100+ participating organizations in 31 US states
- 24 NNCI Webinars since 2021
- NNCI-Wide REU Convocation and Multi-site RET Program
  - 7 REU Convocations hosted with 450+ students



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2023 NNCI User Survey

Responses: 1,090 (68% NNCI university, 13% non-NNCI academia, 16% Industry)

How did you find out about NNCI facility?

1. Current/former user
2. Referral from user
3. University website
4. Web search
5. Direct contact by facility

Facility had a **positive impact** on my work: 94.5% Agree or Strongly Agree

Level of civility: 95.6%% rated Good, Very Good, Excellent

Overall satisfaction: 92.1% Somewhat or Extremely Satisfied

Would you **recommend** the NNCI facility to a colleague? 96.3% Yes

200+ tool/service suggestions were received and provided to the sites

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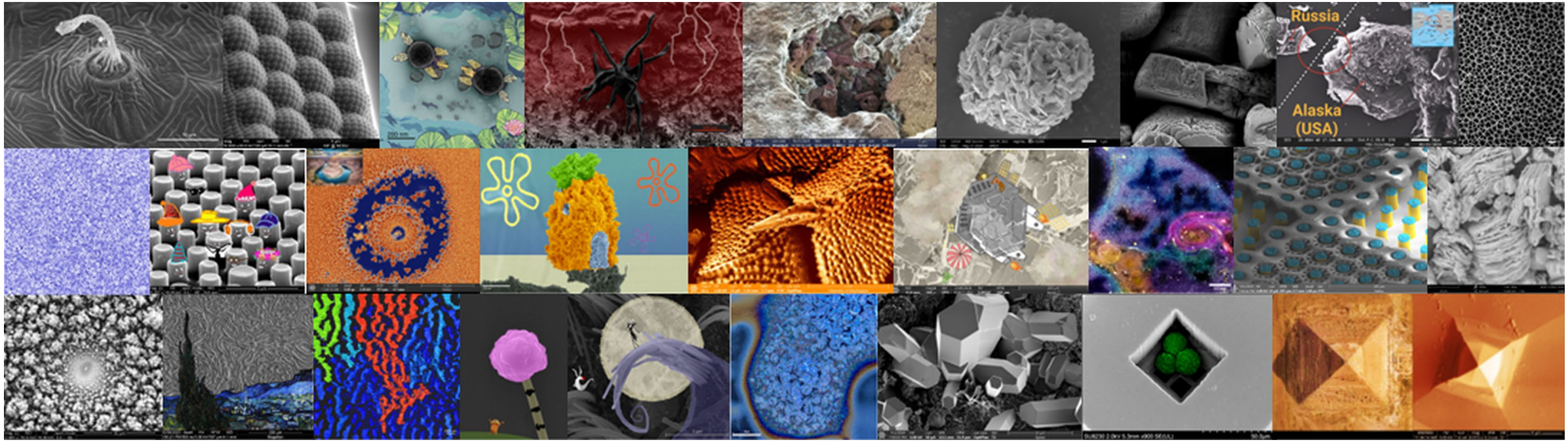
Plenty of Beauty at the Bottom Image Contest



Winners and Honorable Mentions to be announced by Associate Director for Education & Outreach!

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2024 Conference Site Reports & Panel Topics

What are examples of programs and activities developed under NNCI that will be sustainable, independent of any continued NSF renewal funding, and what strategies or sources will be used to support them?

- What are you doing now and how can a future infrastructure better reach out to **underserved communities** (for example, rural areas, underrepresented groups, or low research activity institutions)?
- For NNCI **Research Communities**, what worked, what didn't, and what are suggestions for what a future network might implement to support national priority research topics?
- What role do **community/technical colleges** play in your education and workforce development strategy and what role should they play in a future infrastructure network?
- How does your NNCI site support **translation of research to the commercial sector** and what more could be done?

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Thank You!

http://www.nnci.net