Coppin Technology & Research Readiness Showcase

Moderator: Dr. Denyce Watties-Daniels, Chairperson of Coppin's Faculty Research and Development Committee

Panelists:

Thomas Smith, *MD-REN*; Dr. Dondra Bailey, *Coppin State University*; Dr. Mintesinot Jiru, *Coppin State University*; Taha Mohammed, *Coppin State University*; Marcus Hammond, Coppin State University; Tamara Petronka, *Maryland Enterprise Education Consortium;* Zayed Mohammed Uddin, *Student, Coppin State University*

Coppin State University Technology & Research Readiness Showcase

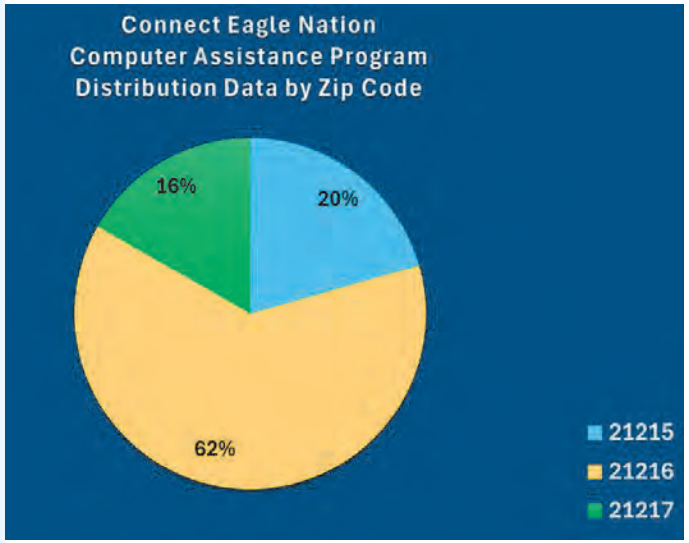
MS-CC Workshop
Tuesday, September 30, 2025

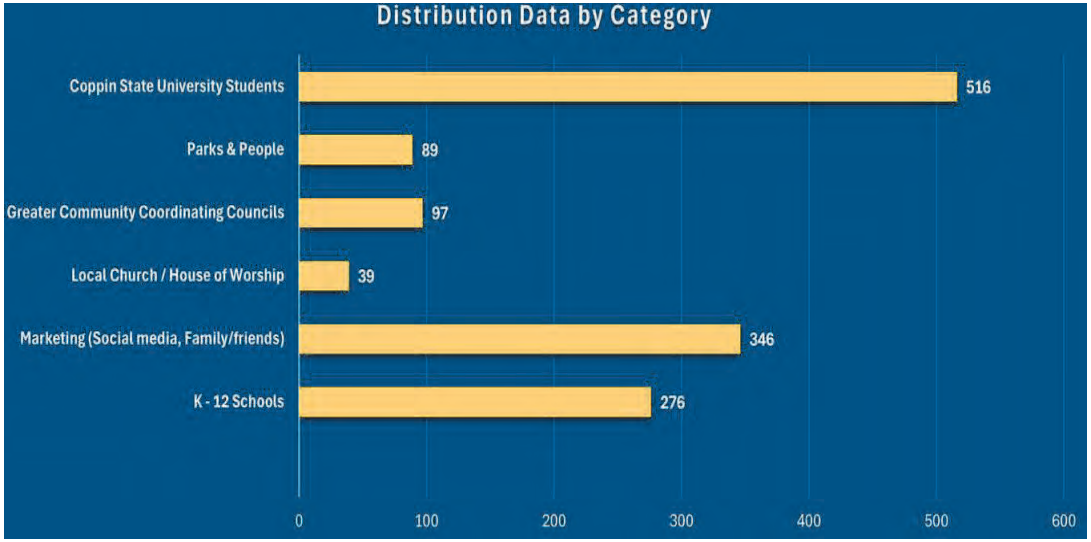
Agenda

Dr. Denyce Watties-Daniels, Moderator

- **Harnessing MD-REN and External Connectivity for Research and Innovation**
  Mr. Thomas R. Smith, III
- **Advancing Teaching and Research with a Modernized Network**
  Mr. Taha Mohammed
- **Transforming Teaching, Learning, and Research Possibilities with Azure Labs**
  Mr. Marcus Hammond
- **Procurement with Purpose: Leveraging MEEC to Expand Technology Research Capacity**
  Ms. Tamara Petronka
- **Transforming Access and Equity through "Connect Eagle Nation" NTIA Broadband Grant**
  Dr. Dondra Bailey and Dr. Mintesinot Jiru
- **Performance and Sustainability Analysis of CH_3NH_3, CH_3NH_2Sn, and CH_3NH_2Br Based Perovskite Solar Cells via SCAPS-1D Simulation**

Computer Assistance Program
1,400 laptops distributed to Anchor Community residents





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MDREN Benefits and Impact on Research Computing

Enhancing collaboration and innovation through advanced networks

Thomas R. Smith, III
Chair, MDREN Executive Board
Deputy Chief Information Officer
Division of Information Technology
Coppin State University

September 2025

MDREN

What is MDREN?

Maryland Research and Education Network (MDREN)

Statewide High-Speed Backbone

MDREN provides a high-speed backbone connecting universities, colleges, and research labs across Maryland for seamless collaboration.

Global Research Connectivity

MDREN links Maryland institutions to national and global research networks, expanding their research capabilities and reach.

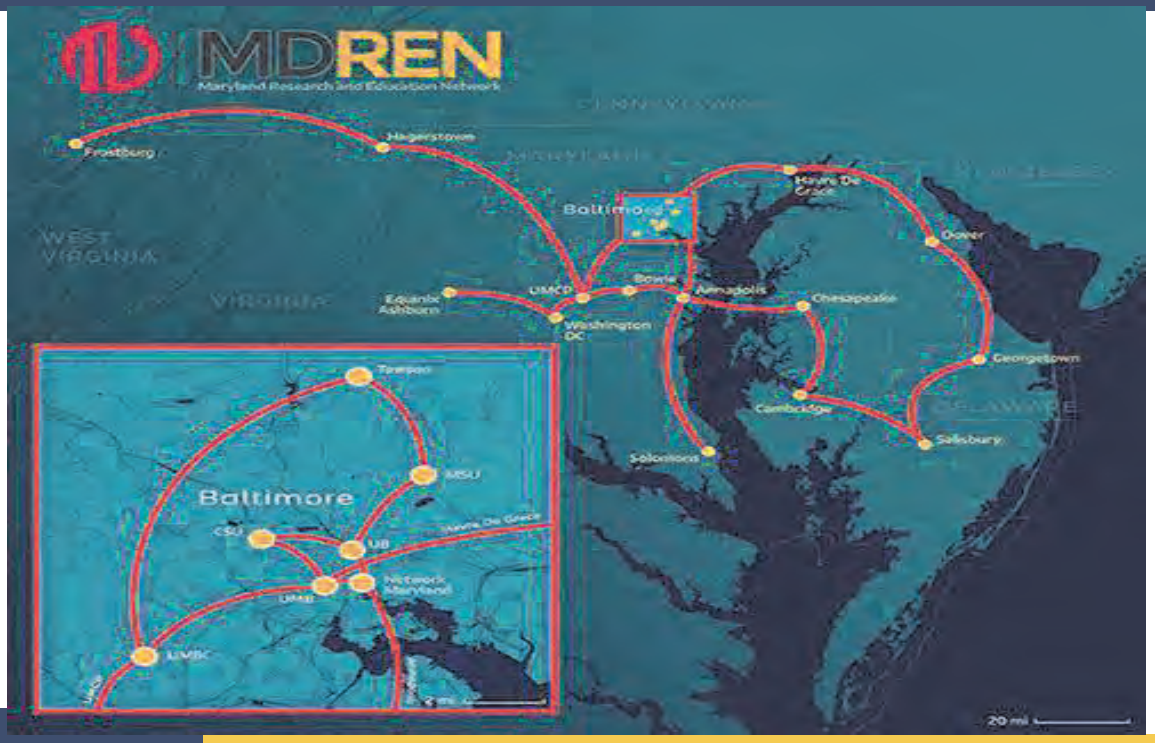
Optimized for Research Needs

MDREN is designed with high throughput and low latency to support real-time collaboration and large data transfers.

Enhancing Research & Education

MDREN offers scalable networking solutions that strengthen Maryland's research and educational landscape.

MDREN


MDREN
Maryland Research and Education Network
Frostburg
Hagerstown
Baltimore
Havre De Grace
Ocean
WEST VIRGINIA
VIRGINIA
Bowie
Annapolis
Chesapeake
UMCP
Equanix Ashburn
Washington DC
Georgetown
Cambridge
Salisbury
Salisbury
Towson
Baltimore
MSU
CSU
UB
Havre De Grace
Network Maryland
UMB
UMBC
UMCP
20 mi

Core Services Offered by MDREN

High-Speed Network Connectivity

MDREN upgrades include a 400Gb core backbone and 100Gb campus links to support fast, reliable connectivity.

Cloud and Internet2 Access

The network offers direct access to Internet2 and major cloud providers to enhance computing and storage capabilities.

Content Delivery and Security

Peering with content providers and DDoS mitigation services optimize content delivery and network security.

Collaboration and HPC Access

MDREN provides video conferencing, collaboration tools, and HPC pilot programs for smaller campuses.

Benefits for Research Computing

Advantages of MDREN for Researchers

High Performance Connectivity
MDREN provides high throughput and low latency, enabling large data transfers and real-time collaboration for researchers.

Cost Efficiency
Shared backbone infrastructure and peering arrangements reduce costs significantly for member institutions.

Access to HPC and Cloud
Researchers gain direct access to high-performance computing and cloud services, improving workflow efficiency.

Security and Collaboration
Robust security ensures data protection while fostering a collaborative community for sharing expertise and resources.

Impact and Use Cases

Real-World Applications of MDREN

Bandwidth Expansion for Underserved Areas
MDREN expands bandwidth for rural and underserved campuses, ensuring equitable high-speed internet access through NSF grants.

High Performance Computing Support
The HPC pilot program enables small institutions in USM to engage in advanced research with enhanced computing resources.

Regional Collaboration and Infrastructure
MDREN's partnership in the Mid-Atlantic Ring with KeystoneREN and University of Delaware strengthens regional research networks.

Support for Advanced Research Fields
MDREN supports cutting-edge AI, data science, big data, and hybrid cloud computing for innovative research.

Challenges and Considerations

Obstacles in Network Expansion

Last-mile Network Bottlenecks
Last-mile connectivity issues at campuses create performance bottlenecks that limit the network's overall efficiency.

Funding and Sustainability
Ongoing infrastructure upgrades require strategic funding plans to ensure long-term sustainability and growth.

Coordination Complexity
Multiple institutions must coordinate governance and resource allocation, adding layers of complexity to network expansion.

Security and Training
Ensuring data privacy and training researchers on HPC and cloud tools is essential for secure, effective network use.

Future Directions

Strategic Goals for MDREN

Network Backbone Upgrade
Upgrading to a 400Gb backbone will significantly enhance Maryland's network capacity and performance.

HPC Program Expansion
Expanding the pilot HPC program into a permanent service ensures consistent access to advanced computing resources.

Regional Research Network
Building a Mid-Atlantic research network ring will improve collaboration and connectivity among institutions.

Cloud Integration and Support
Integrating with cloud providers enhances scalability while training programs support effective resource use.

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Advancing Teaching and Research with a Modernized Network

Taha Mohammed
Assistant Director Campus Infrastructure Team
Division of Information Technology
Coppin State University

Why Modernize Educational Network?

- Modern education relies on high-speed, secure, and scalable networks
- Teaching and research demand uninterrupted access to digital tools, cloud, and data
- Smart Classrooms Technologies
- LMS - Blackboard with reliable access
- Hybrid/Remote Learning: Consistent performance regardless of student location

Research in the Age of Data

- High-Performance Computing (HPC): Fast data processing and modeling
- Collaboration Tools: Real-time data sharing with researchers worldwide
- Data Storage & Retrieval: Access large datasets without lag
- Secure Research Environments: Compliance with data privacy standards

Aging Infrastructure

- Installed in 2013
- Old architecture that was not build for modern IT networks
- Prone to downtime
- No software upgrade or patches available
- De-centralized Management

Network Upgrade Project

- 2022 Project approval
- Vendor discussion
- Hands-on equipment testing
- Finalizing vendor, proposal and architecture
- Gartner vetting
- Budget
- Spring 2024 PO issued

- Extreme Networks selected
- Inside-Out phased project approach
- Phase 1 – Datacenter – Summer ‘24
- Phase 2 – Core Upgrade – Summer ‘24
- Phase 3 – Campus Buildings – Fall ‘24
- Phase 4 – SmartClass Rooms – Spr ’25

- 8 Datacenter Switches – 2 locations
- 4 Core Switches – 4 locations

Outcomes

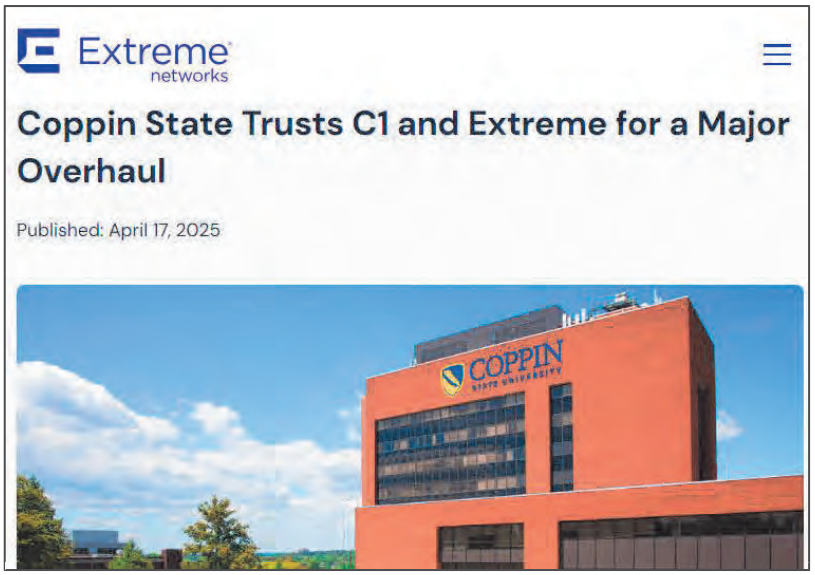
- Modern Network with student centric approach
- Supports high bandwidth to accommodate growing network needs
- Better Wi-Fi connectivity across campus
- Centralized Management
- Reliable connectivity for learning
- Fully reductant design
- Support for data-intensive projects
- Foundation for advanced digital initiatives like AI, Research Initiatives, VR, etc.

Statistics

- Edge connectivity – 20Gbps to 50Gbps – dual redundancy
- Core backbone capacity – 40Gbps to 100Gbps – Full redundant mesh design
- 400% increase in WiFi connectivity – 1Gbps to 5Gbps per AP*
- Datacenter backbone supports 100Gbps connectivity – Full redundant mesh design
- Two internet connection at 25Gbps – 100Gbps planned
- Wi-Fi only Dorm Rooms

Case Studies

C1 Case study:
https://www.onec1.com/resources/case-study/coppin-state-university



Extreme Case Study:
https://www.extremenetworks.com/resources/case-study/coppin-state-trusts-c1-andextreme-for-a-major-overhaul

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Azure Lab Services

Transforming Teaching, Learning, and Research Possibilities

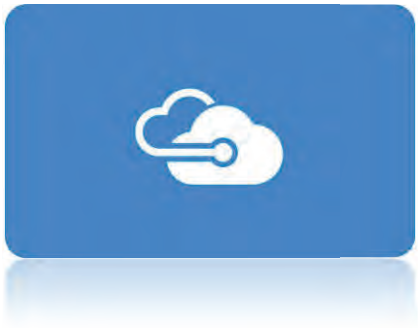
September 2025

Agenda

- What is Azure Lab Services?
- Benefits of Azure Lab Services
- Azure Lab Services @CSU
- Summary

What is Azure Lab Services?

- Microsoft's Cloud Computing platform
- Computer Labs in the cloud



Benefits of Azure Lab Services

Flexibility…..

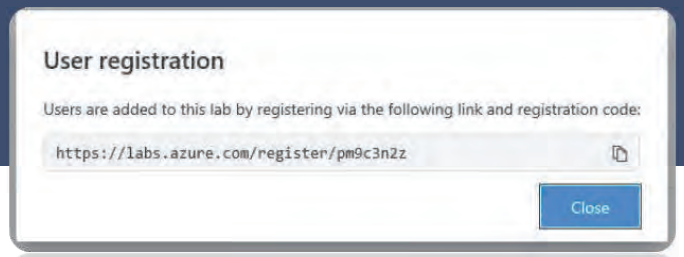
- Build Windows or Linux environments
- Create and Experiment
  - Ideal for deploying labs for
    - courses, hack-a-thons, hands on labs,
    - Environments for demo,
    - PCs Development and test environments
  - Provision each lab with specific software and settings

Benefits of Azure Lab Services

Accessibility…

- Access Any Time, Any Where, Any Device
- Single Sign on available

Benefits of Azure Lab Services

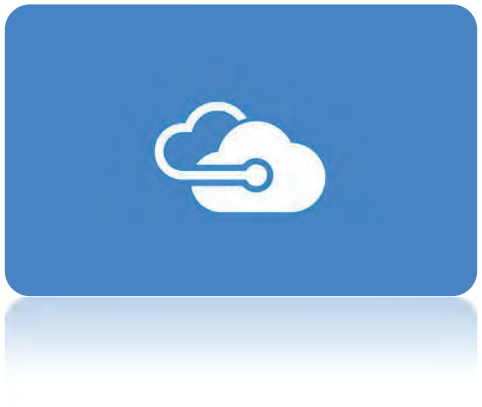


Simple and easy to use…

- Share Labs via sharing feature or URL link
- From a dashboard, lab users can easily join and view resources
- Lab resources are schedulable

Benefits of Azure Lab Services

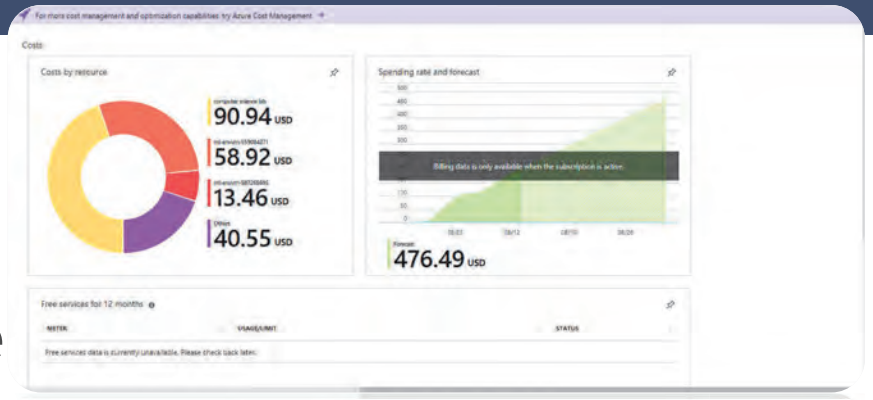
Cost optimization…



- No upfront cost
- No termination fees
- Pay as you go
- Per-hour billing
- Streamline costs with usage parameters, by user or by lab

Benefits of Azure Lab Services

Dashboard Analytics…



- Track recipient's lab use
- See activity trends such as usage and cost from our dashboard

Azure Lab Services @CSU

The Pilot Lab….

- Talon Lab - 50 PCs
- Shared by 3 Professors in Comp Sci
- 30 Users Registered
- Over 5000 user hours

Azure Lab Services @CSU

The Pilot Lab….

User reactions

- » "Very fast, I like it", S. Acharya
- » "I will be using it for my class", A. Gonzalez
- » "This is great, it like I have my own pc in the cloud", M. Johnson

Azure Lab Services @CSU

Currently….

- Total # of Semesters 14
- Total # of Courses 118
- Total # of Labs 117
- Total # of Stud PCs 766
- Total # of Computing Hrs. 33,943

Azure Lab Services @CSU

Top courses @CSU that use Azure

- MISY 356 12 times
- COSC 199 11 times
- MISY 360 10 times
- MISY 355 8 times
- COSC 406 7 times
- COSC 316 7 times
- COSC 312 6 times
- COSC 409 5 times
- COSC 221 5 times

Summary…

» Azure Lab Services revolutionizes teaching, learning, and research by providing a scalable, cost-effective, and managed virtual lab environment in the cloud.

» Azure Lab Services eliminates the need for expensive, on-premise physical computer labs and allows students and researchers to access powerful computing resources from anywhere, on any device, at anytime.

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Maryland Education Enterprise Consortium

SEPTEMBER 2025

MEEC Defined!

Hosted by the University System of Maryland

- Member open to K-20 public, private, federal institutions and libraries
- MEEC leverages its size to negotiate IT Hardware, Software and Services Contracts
- Approximately 200 member institutions including all USM, CC and K-12 public institutions
- 250,000 FTE of Faculty and Staff
- 1.25M Students

Contracts

Solicitation

- Sole Source
- Single Vendor Award
- Multi-vendor Award

Discounts and Savings

MEECs Value Add

- Ease of use saves time
- Terms & Conditions established
- Higher brand discounts / Lower max hourly rates
- Members receive at minimum the discount negotiated
- Members can always further negotiate
- Multi-Vendor contracts provides options

Beyond the Contracts

Member Engagement

- Newsletter
- Vendor Webinars / Event Journal
- Member Conference and Vendor Showcase
- Outreach

Help MEEC!

- Volunteer
- Complete Surveys
- Spotlight / Member Webinars
- Conferenc

Help You!

- Interaction with Members
- Gain Knowledge
- Share Knowledge

MEEC

Contact

- www.meec-edu.org
- meecadmin@usmd.edu
- tpetronka@usmd.edu

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CONNECT EAGLE NATION

National Telecommunications and Information Administration (NTIA)

Connecting Minority Communities (CMC) Pilot Program

Connect Eagle Nation

Dondra Bailey (PI) and Mintesinot Jiru (Co-PI)

MS CC

September 30, 2025

Overall Program Goal

NTIA - Office of Minority Broadband Initiatives (OMBI)

Working to directly address the lack of broadband access, connectivity, adoption, and equity to close the digital divide.

Connecting Minority Communities Pilot Program (CMC)

- **$268 million grant program supporting HBCUs, TCUs, and MSIs.**
- **Funds can be used to purchase broadband internet access and eligible equipment.**
- **Supports hiring and training of information technology personnel.**

Data Snapshot: Digital Literacy & Access in West Baltimore

Broadband Access: 40.7% of Baltimore households lacked wireline broadband (ACS, 2018). In Coppin's Anchor communities, ~46% lack broadband.

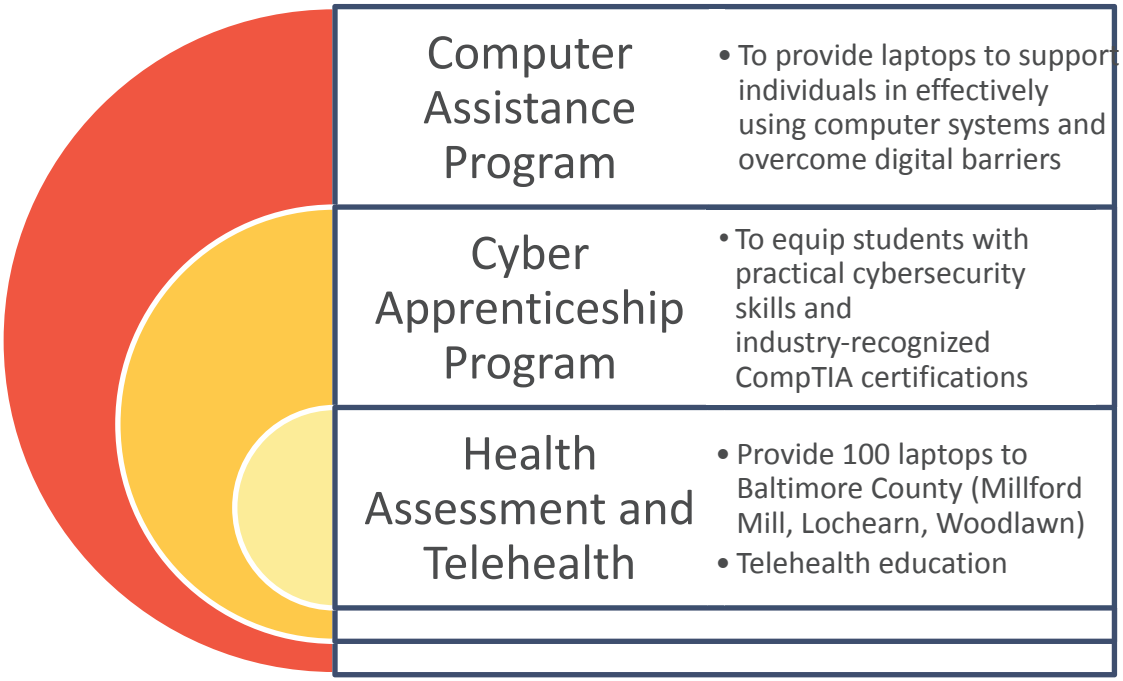
Device Access: One in three Baltimore households lack a desktop or laptop computer. In anchor communities, ~28% have no computer.

Skills Gaps: 92% of U.S. jobs require digital skills, yet one in three workers lack them (National Skills Coalition, 2021).

Equity Context: Anchor neighborhoods have ~25,400 residents; 91% identify as Black or African American; nearly half fall below 250% of the poverty threshold.

Source: US Census Bureau, American Community Survey (ACS) 2016-2020

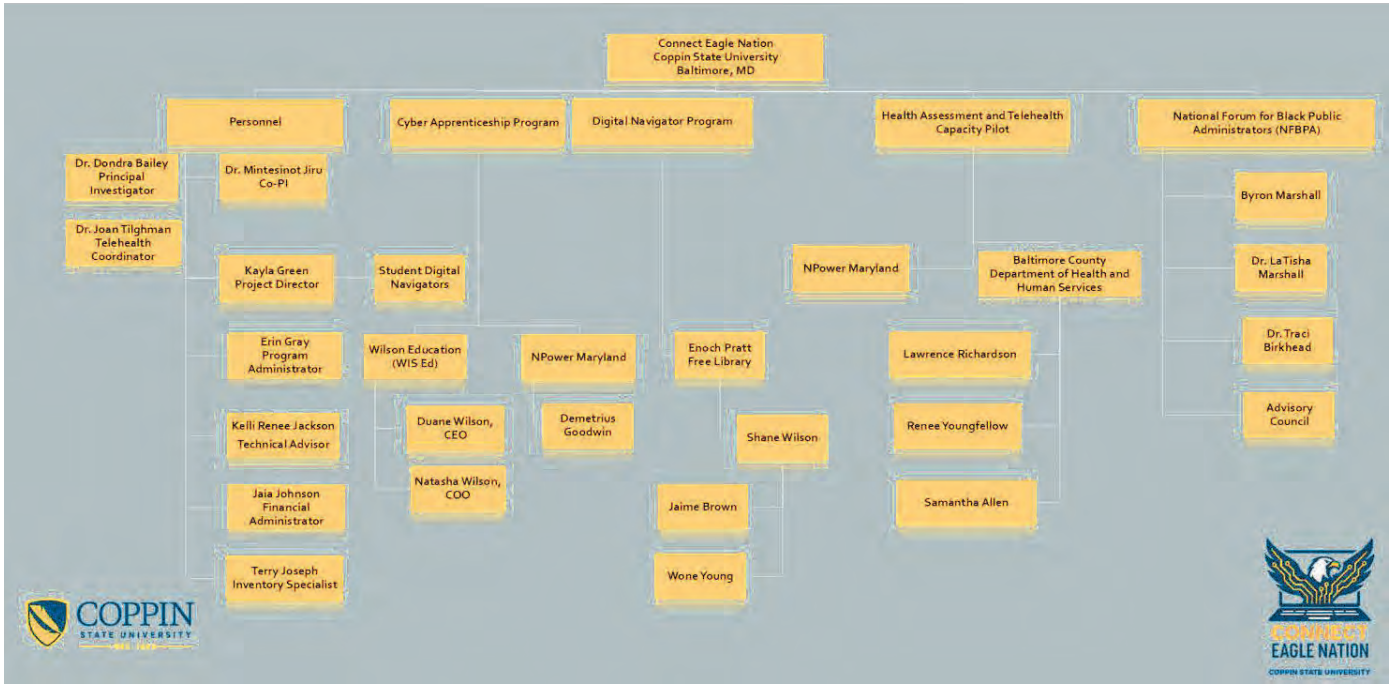
Goals and Programmatic Activities



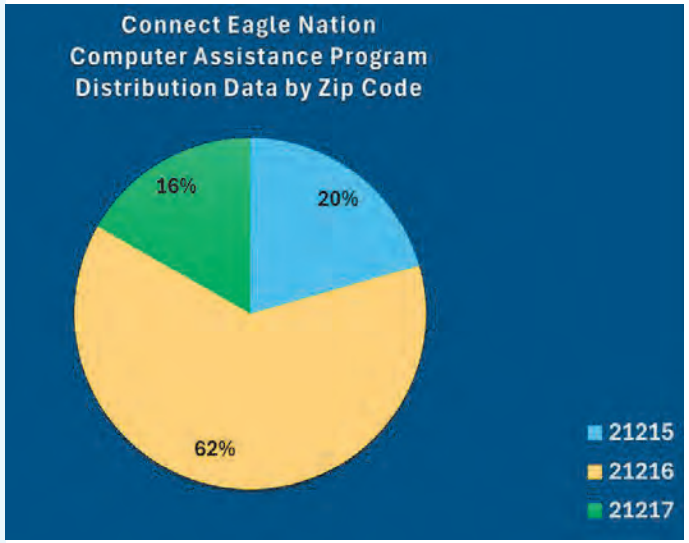
Computer Assistance Program	• To provide laptops to support individuals in effectively using computer systems and overcome digital barriers
Cyber Apprenticeship Program	• To equip students with practical cybersecurity skills and industry-recognized CompTIA certifications
Health Assessment and Telehealth	• Provide 100 laptops to Baltimore County (Millford Mill, Lochearn, Woodlawn) • Telehealth education

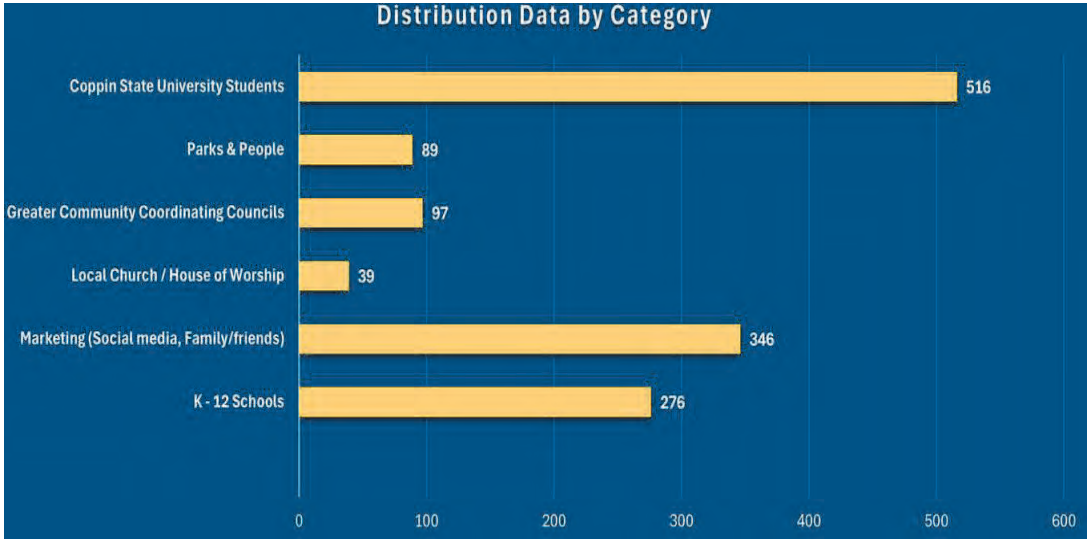
CONNECT EAGLE NATION

Organizational Chart



Computer Assistance Program
1,400 laptops distributed to Anchor Community residents





Connect Eagle Nation Impact

- Partnered with NPower for Resource Fair on June 17, 2025, at CareFirst
- Partnering with Baltimore City for Digital Literacy Resource Fair (1st for West Baltimore) – October 9, 2025
- Digital Navigation Program in partnership with Enoch Pratt trains Coppin student Navigators and builds digital navigation courses and workshops.
- Workforce training through WIS ED (CompTIA) and NPower (CompTIA and Google certifications), preparing participants for IT careers. Training has been provided for over 60 students.
- Quarterly Advisory Council guiding development of a West Baltimore Digital Equity Strategic Plan.

Impact: Health Assessment and Telehealth

- 100 Laptops distributed through the Baltimore County Health Department to eligible community members with chronic illnesses.
- Telehealth education led by NPower with oversight from Coppin's School of Nursing, expanding healthcare access.

Sustainability Strategic Plan

- Three Digital Hubs across campus: Library, Science and Technology Center, College of Business
- Strengthen community partnerships
- Expand graduate coursework, work-study, and internships to support program evaluation and digital navigation.
- As an anchor institution, Coppin will continue to bridge the digital divide in the surrounding communities

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CONNECT EAGLE NATION

Website
https://www.coppin.edu/connecteaglenation

Email
ConnectEagleNation@coppin.edu

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Perovskite Solar Cells

Material Comparison, Unsupervised Learning Analysis & SCAPS-1D simulation study

September 30, 2025

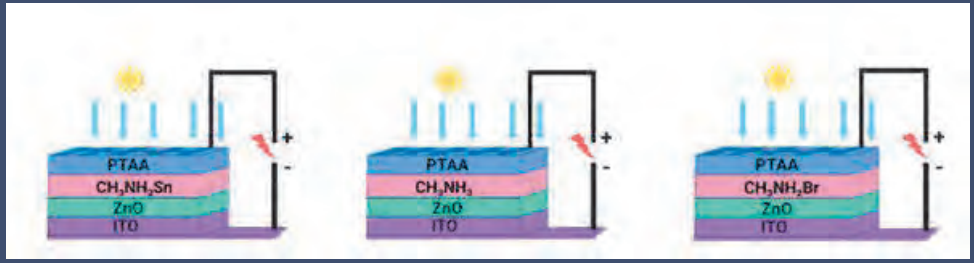
Outline

- Introduction & Motivation
- Simulation Setup & Device Architecture
- Quantum Efficiency & Absorption
- I–V Characteristics & PCE
- Electrical Metrics & Defect Influence
- Unsupervised Clustering Analysis
- Conclusions & Outlook

Introduction & Motivation

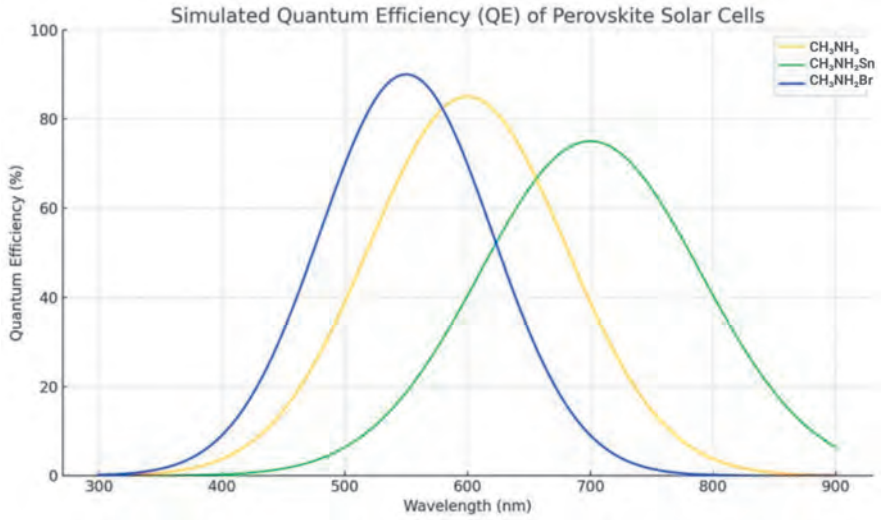
- Perovskite solar cells (PSCs) have achieved record efficiencies exceeding 25%, outperforming many commercial PV technologies.
- Lead toxicity and environmental concerns motivate the search for lead-free alternatives, such as tin- and bromide-based perovskites.
- Our study compares CH_3NH_3, CH_3NH_2Sn, and CH_3NH_2Br under identical SCAPS-1D conditions to evaluate optical, electrical, and device metrics.

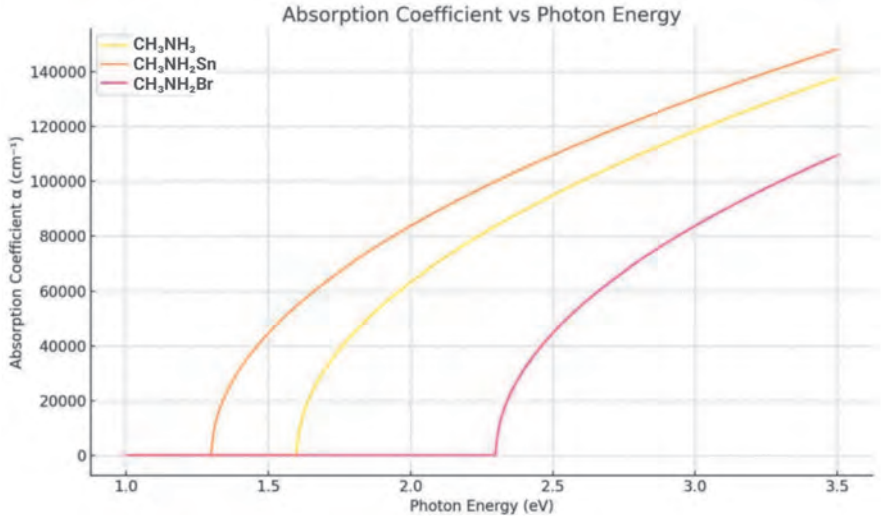
Simulation Setup & Device Architecture



- p-i-n planar heterojunction: ITO / PTAA / Perovskite / ZnO / Ag
- SCAPS-1D simulations under AM 1.5 G illumination (1000 W m^{-2}) at 300 K
- Absorber thickness 300–500 nm; defect density 10^{14}–10^{16} cm^{-3}; material parameters from literature
- Evaluate quantum efficiency, I–V, series resistance, defect influence and clustering

Quantum Efficiency & Absorption



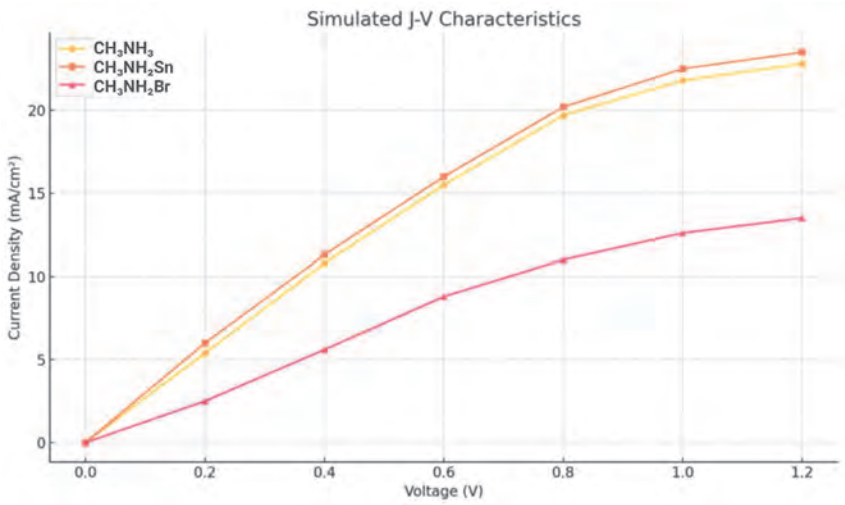


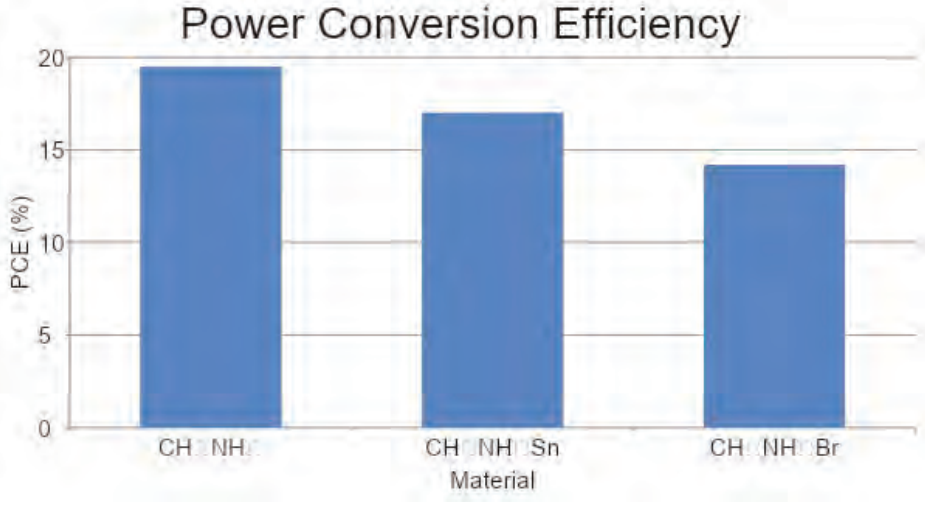
- CH_3NH_3 peaks near 600 nm – balanced absorption
- CH_3NH_2Sn peaks near 700 nm – red-shifted absorption
- CH_3NH_2Br peaks near 550 nm – high-energy photons

- CH_3NH_2Sn (1.3 eV) absorbs into infrared
- CH_3NH_3 (1.6 eV) covers the visible spectrum
- CH_3NH_2Br (2.3 eV) absorbs UV/blue photons

These two plots indicate the (wavelength vs bandgap): each material “specializes” in a different slice of the spectrum.

I–V Characteristics & PCE

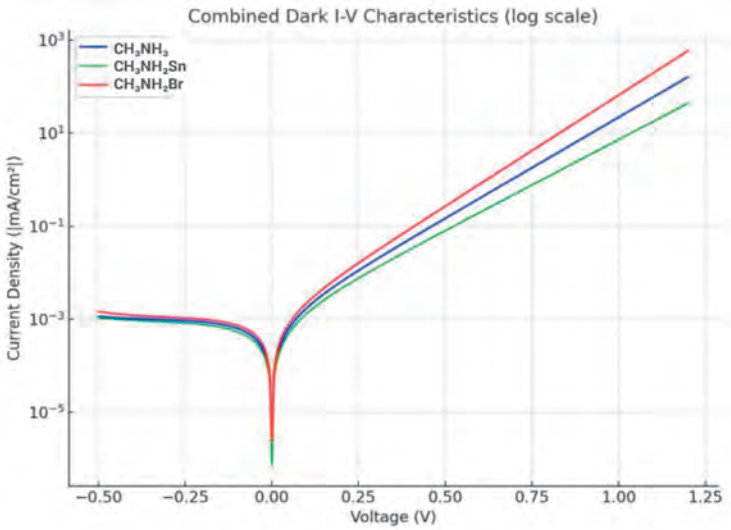


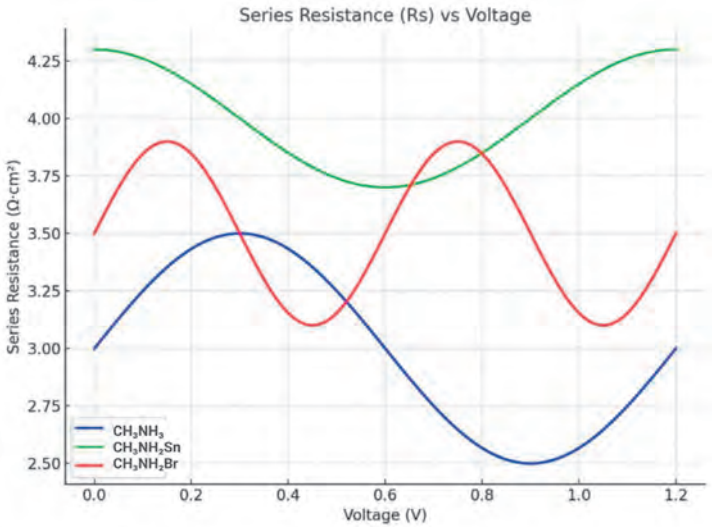


- CH_3NH_3 shows the highest current density and balanced V_{OC}
- CH_3NH_2Sn has high photocurrent but slightly lower V_{OC}
- CH_3NH_2Br delivers the lowest current due to its wide bandgap
- PCE: 19.5 % (CH_3NH_3), 17.0 % (CH_3NH_2Sn), 14.2 % (CH_3NH_2Br)

In single junctions, the balanced gap of CH_3NH_3 wins; Sn's long-λ boost doesn't fully compensate its lower Voc; Br trades current for higher-energy photons.

Dark I–V Characteristics & Series Resistance

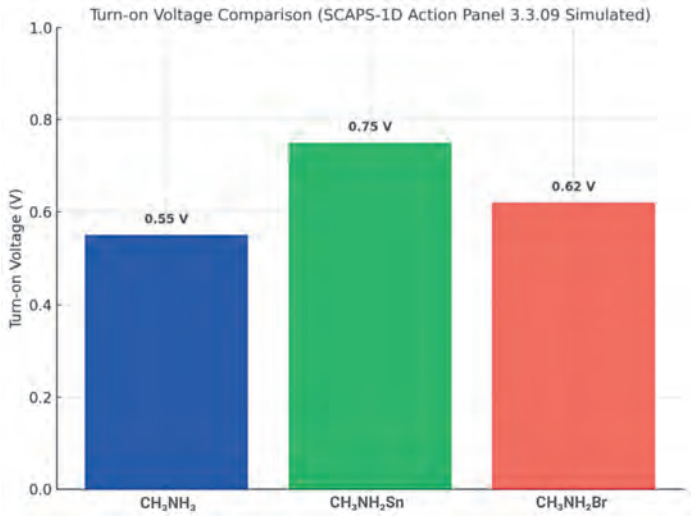


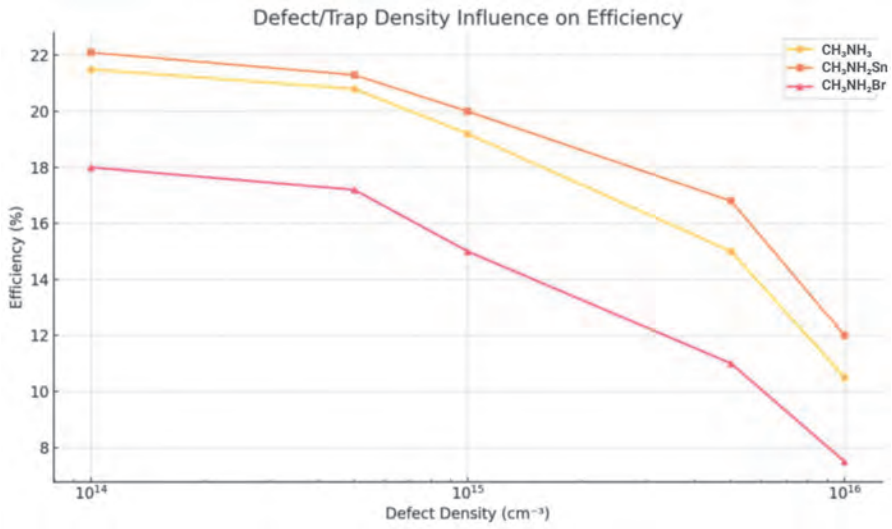


- CH_3NH_2Br exhibits the highest forward dark current; CH_3NH_2Sn the lowest
- All materials show negligible reverse leakage, indicating good diode quality

- Series resistance decreases with voltage from ~3.7 to ~2.5 Ω·cm²
- Average Rs: 3.05 (CH_3NH_3), 4.04 (CH_3NH_2Sn), 3.55 Ω·cm² (CH_3NH_2Br)

Turn-on Voltage & Defect Impact



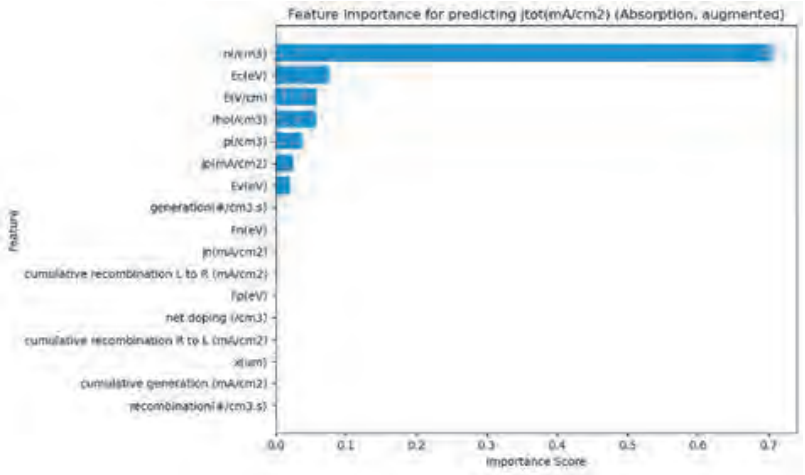


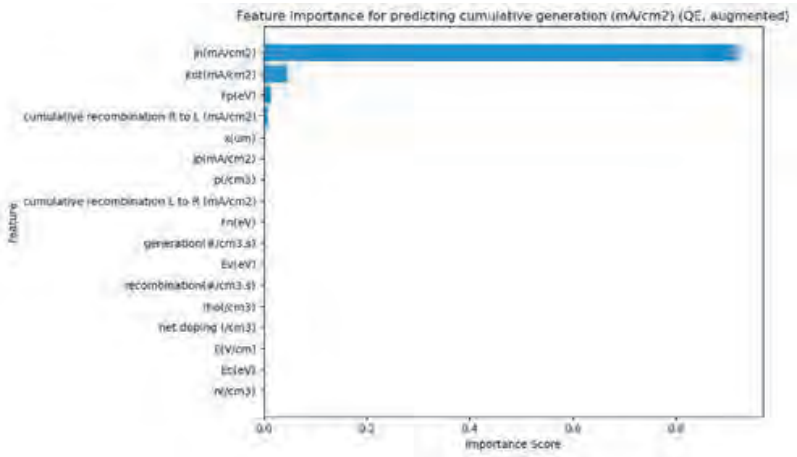
- Turn-on voltage: 0.55 V (CH_3NH_3) < 0.62 V (CH_3NH_2Br) < 0.75 V (CH_3NH_2Sn)
- Increasing defect density reduces efficiency; CH_3NH_3 and CH_3NH_2Sn are more tolerant than CH_3NH_2Br
- CH_3NH_2Br's efficiency drops steeply at high trap densities

Turn-on favors CH_3NH_3 for low-light conditions. Defect control matters for all, but Br-rich devices need tighter process control.

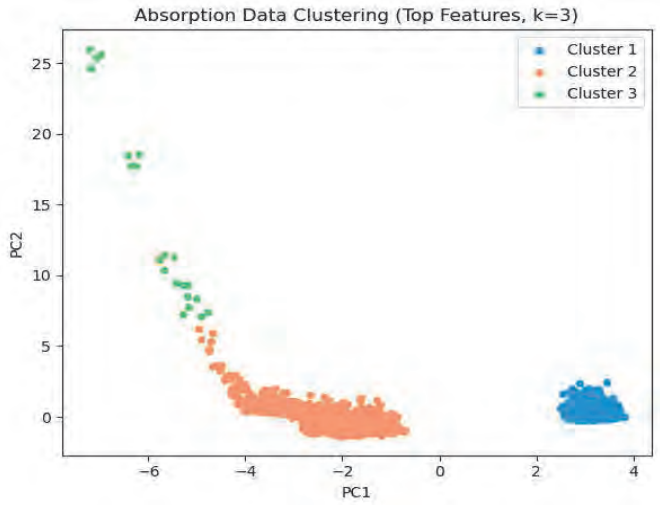
Unsupervised Clustering Analysis

- Data prep: add ~5% physics-consistent Gaussian noise to expand datasets (Absorption ~660⟶2,648; QE 400⟶1,600); select top features via RF importance; StandardScaler.
- Clustering: k-means (k=3) on selected features; PCA used only for visualization; strong quality metrics (Silhouette > 0.5, DB < 1, high CH)
- Interpretation: three well-separated regimes; materials leave distinct “fingerprints” in optoelectronic behavior; median profiles summarized.

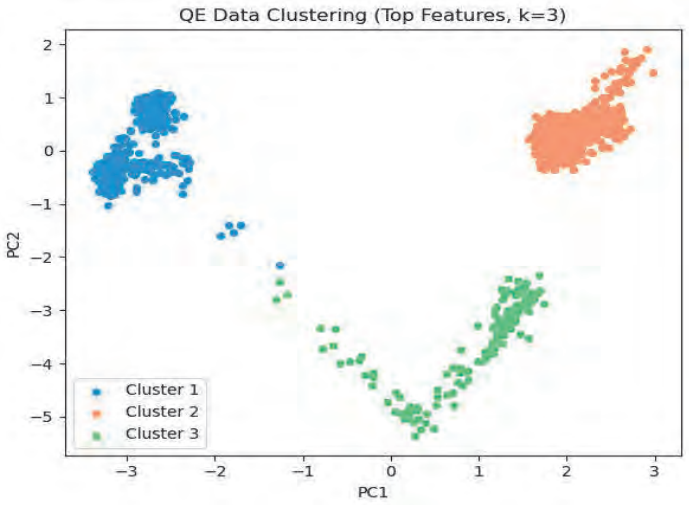




Unsupervised Clustering Analysis



Clusters map to device physics: (i) bulk-like quasi-neutral, (ii) more active bulk with moderate field, (iii) interface-dominated high-field region.



The ML view independently rediscovers the regions we reasoned about from the device plots: cross-validation without hand labels.

- k-means (k=3) identified three distinct clusters for absorption and QE datasets
- Silhouette scores: 0.551 (absorption) and 0.694 (QE) – good cohesion and separation
- Davies–Bouldin index < 1 and Calinski–Harabasz > 1900 confirm well-separated clusters

Unsupervised Clustering Analysis

Absorption Coefficient dataset clusters (medians)	Cluster 1	Cluster 2	Cluster 3
n (/cm³)	8.997 × 10^17	3.009 × 10^13	3.409 × 10^–14
p (/cm³)	5.906×10^{10}	3.279×10^{15}	1.370×10^{25}
Ec (eV)	0.077	0.724	2.123
Ev (eV)	−3.547	−1.602	−0.771
E (V/cm)	-6.54×10^{-4}	7.455×10^{3}	4.708×10^{5}

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Translate stats to physics: bulk vs active-bulk vs interface; near-front inactive vs deeper active.

Why ML here?

- Label-free clustering confirms our physics story and cuts bias
- Mild physics-consistent augmentation (≈±5% noise) + scaling + multiple initializations shows clusters are stable (not artifacts)
- Features are physical, so the clusters translate to device regions we can act on
- Quality metrics (Silhouette/DBI/CH) prove the structure is real, not noise
- We keep PCA for pictures only; clustering uses real device features.
- This pipeline is reusable for new absorbers and saves fab time by pointing to the right knobs first

Conclusions & Outlook

- CH_3NH_3: balanced performance with highest PCE (19.5 %) peak QE (~600nm), moderate Rs and lowest turn-on voltage – ideal single-junction PSC
- CH_3NH_2Sn: extends absorption into near-infrared with high photocurrent but lower V_oC and higher Rs; PCE ≈ 17 % – promising for tandem applications
- CH_3NH_2Br: efficiently absorbs high-energy photons but suffers from low PCE (14.2 %) and high dark current; suited for tandem layers
- Unsupervised clustering corroborates distinct material regimes and supports feature-based material selection
- Future work: optimize doping and passivation, develop multi-junction devices, and validate through experiments

THANK YOU.

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