Overview: Driving Ideation to Commercial Scale Powering New York's Advanced Electronics Cluster

Spring, 2021

www.ny-creates.org

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Major Initiatives Timeline

08/98 — SIA Semiconductor Industry Association

07/02 — International SEMATECH North ($320M/5 years)

04/04 — College of Nanoscale Science & Engineering Formed

01/05 — IBM-Albany CSR ($450M)

06/06 — GF – Luther Forest Plant ($12B)

07/08 — $1.5B Packaging R&D & MFG

02/10 — G450C Manufacturing Initiative ($4.4B/5 years)

11/18 — META Center $850M/7 years

9/19 — PEMC & Marcy Nanocenter $1.7B

04/01 — Nanoelectronics Center of Excellence ($150M)

11/02 — Tokyo Electron Ltd. (TEL) Technology Center America

01/05 — ASML R&D Center ($400M/5 years)

07/05 — INVENT ($600M/7 years)

05/07 — International Sematech / NYS Agreement ($300M/5 years)

07/15 — American Institute for Manufacturing Integrated Photonics ($600M/5 years)

01/19 — IBM Research AI Hardware Center ($3.2B/5 years)

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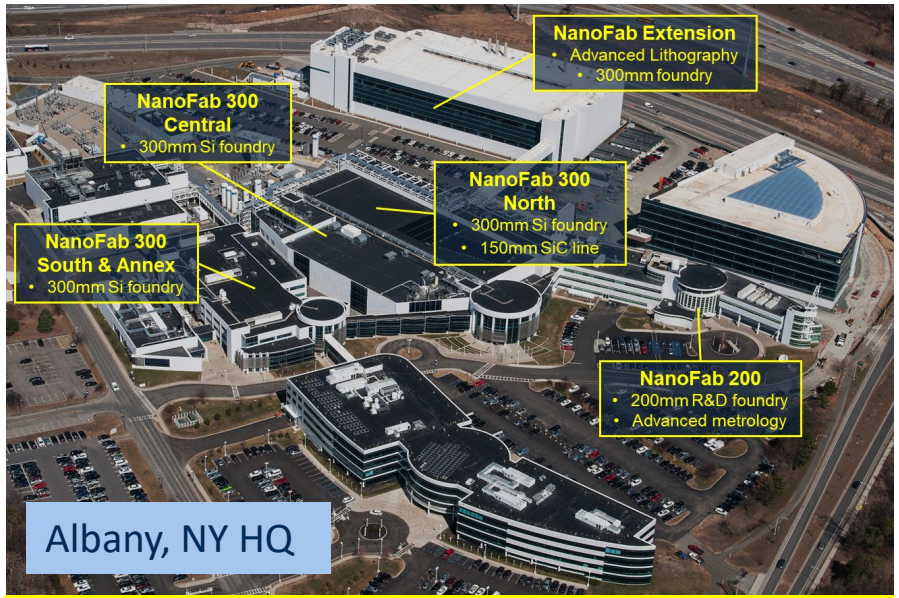
Supporting NY, US & Global Semiconductor Ecosystem

LaMar Hill President's Office
lhill@sunypoly.edu

Douglas Grose Ph.D.
President

Primary Stakeholders

- New York State
- US Government
- Industry
- SUNY RF



- Greater than $15B Investment
- 2,700 Staff, Scientists & Engineers
- 164k ft^2 Clean Room Space
- More than 200 Industry Partners
- $300M/year Operating Budget
- $150M/year Cap-Ex Equipment Budget

Primary Services

- Technology R&D
- Economic Development & Commercialization
- Workforce Development

ONGOING PROGRAMS

- NY CREATES-CSR 300mm FAB
- APPLIED MATERIALS META CENTER
- TEL TECHNOLOGY CENTER AMERICA
- NY PEMC[1] (CREE, DANFOSS)
- IBM AI HARDWARE CENTER
- ROCHESTER TAP[2] FACILITY
- AIM PHOTONICS

1: New York Power Electronics Manufacturing Consortium
2: Rochester Test, Assembly, & Packaging

ONGOING R&D

- AI/NEUROMORPHIC COMPUTING
- INTEGRATED PHOTONICS
- QUANTUM TECHNOLOGIES
- NON-VOLATILE MEMORIES
- POWER ELECTRONICS
- NANOBIO DEVICES
- HETEROGENEOUS INTEGRATION

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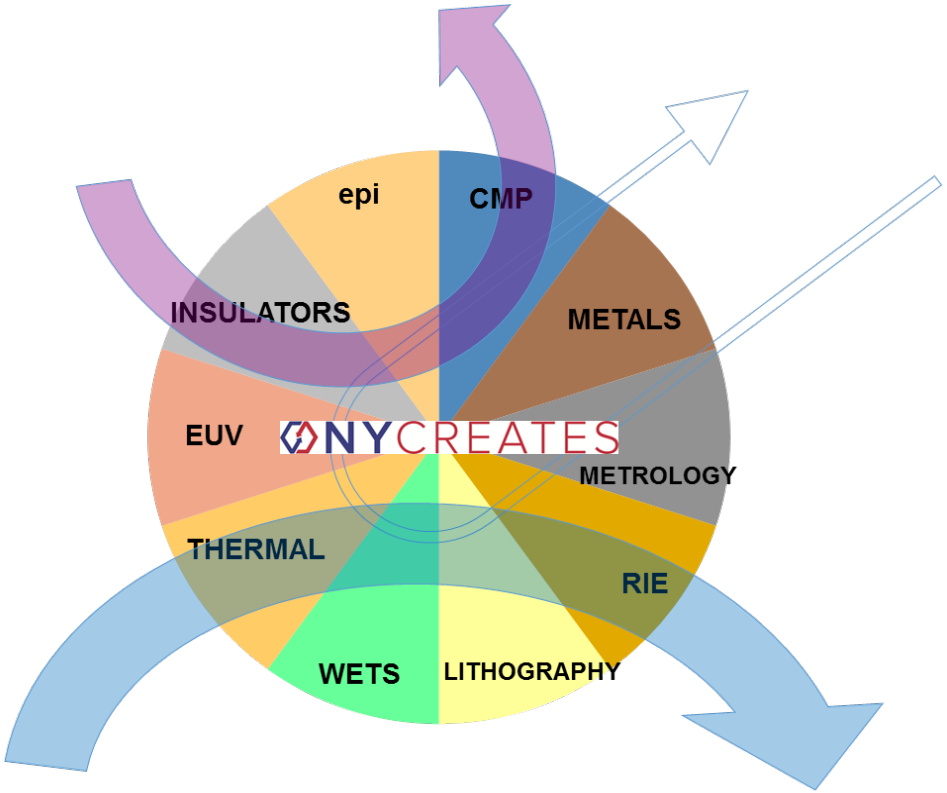
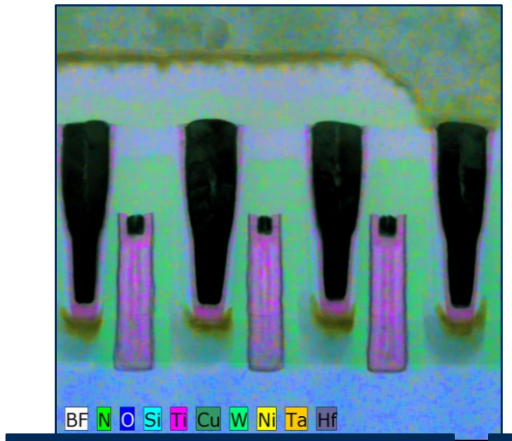
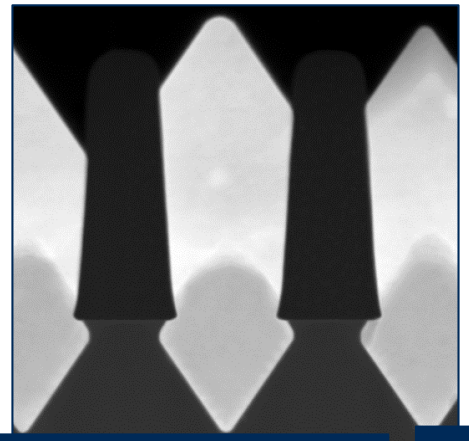
300mm R&D Fab

- Industry technology, equipment and supply chain leaders leverage the state-of-art fab
- NY CREATES team provides:
  - Process development across all sectors
  - Integration and data analysis
  - Operational execution
  - Flexible work scope

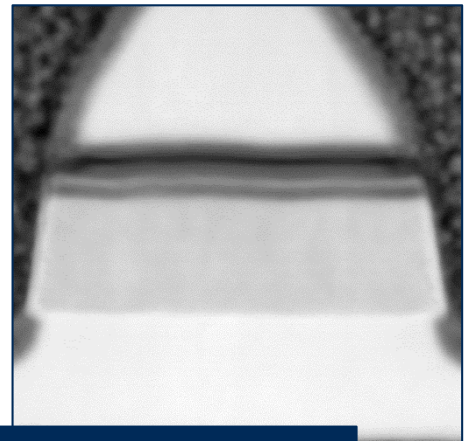




14nm FinFET



III-V Fin



Magnetic Tunnel Junction

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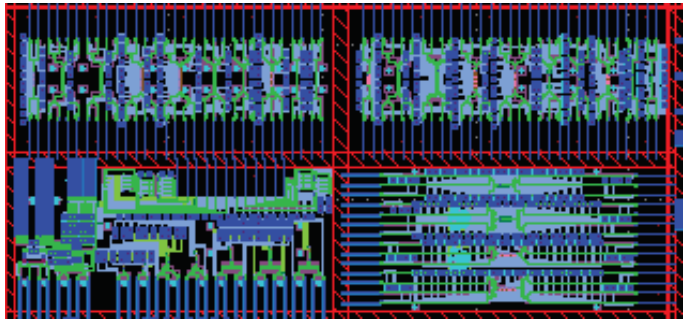
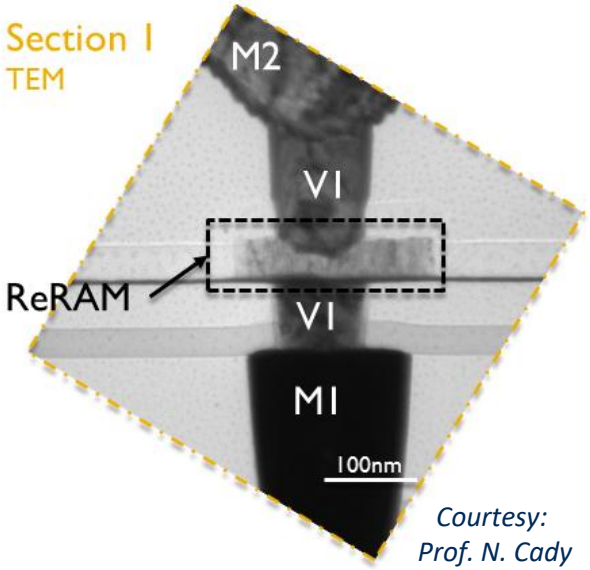
Neuromorphic Computing / AI

Various technologies being explored,
with industry, national labs and academic partners

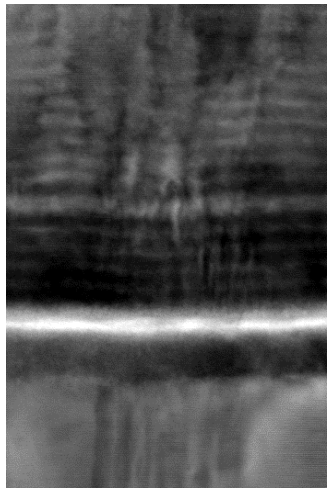
- Resistive RAM
- Magnetic RAM
- Superconducting Optoelectronics
- Photonics
- Ferroelectric RAM
- Phase-Change Memory



Photonic neural network circuits fabricated by AIM Photonics with AFRL-Rome



Courtesy: Prof. N. Cady SUNY Poly



MRAM stack, fabricated at NY CREATES

Cryogenic optoelectronics circuits (by NY CREATES and NIST Boulder)

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Quantum Technologies

- Quantum speed up of specific computational problems
- Quantum simulation / Quantum chemistry
- Quantum sensing (inertial navigation, prospecting, …)
- Quantum encrypted communications and QKD

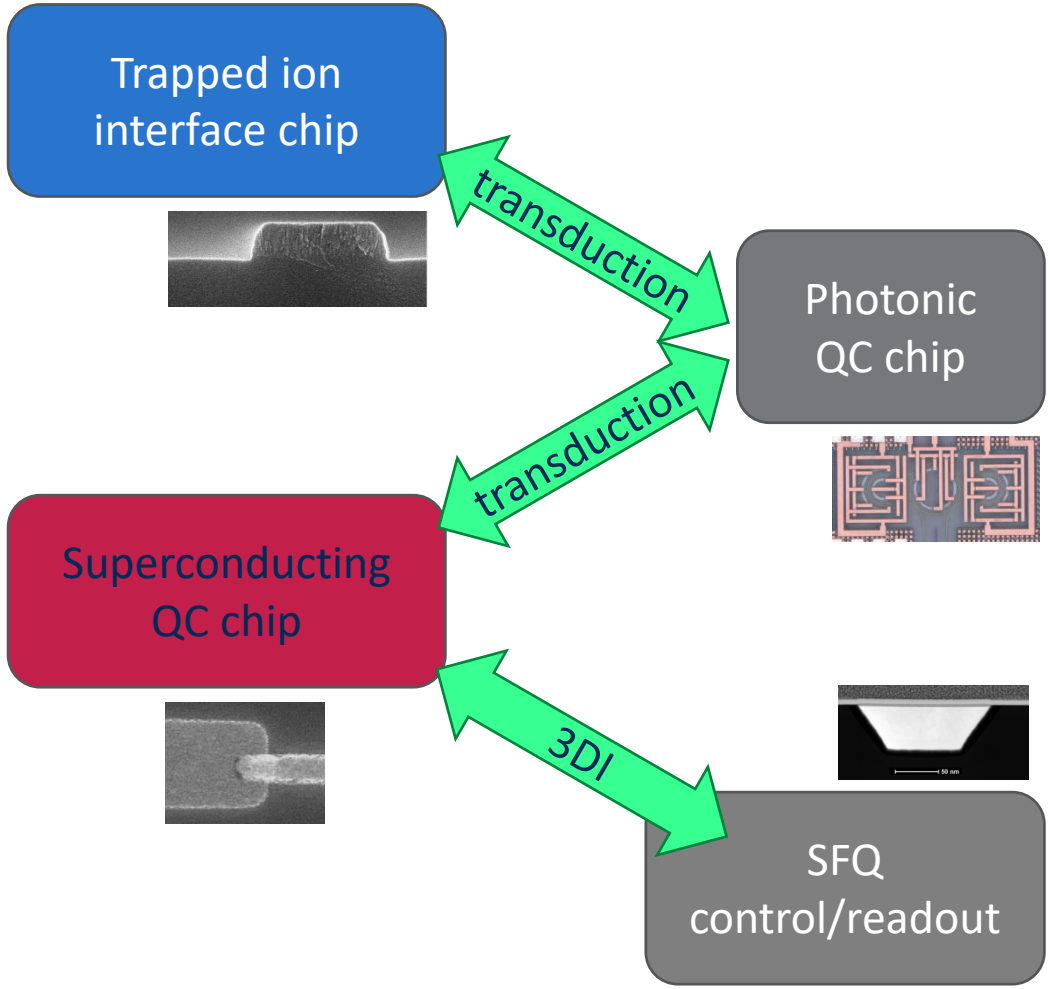

Diagram is for illustrative purposes

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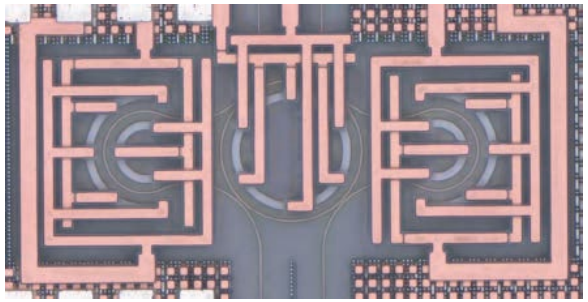
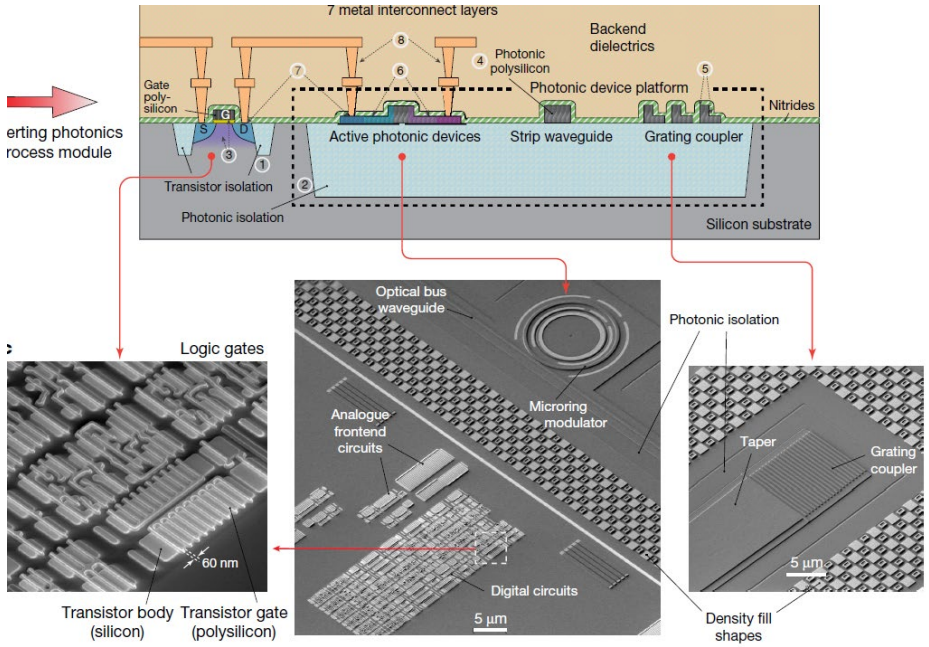
Integrated Photonics

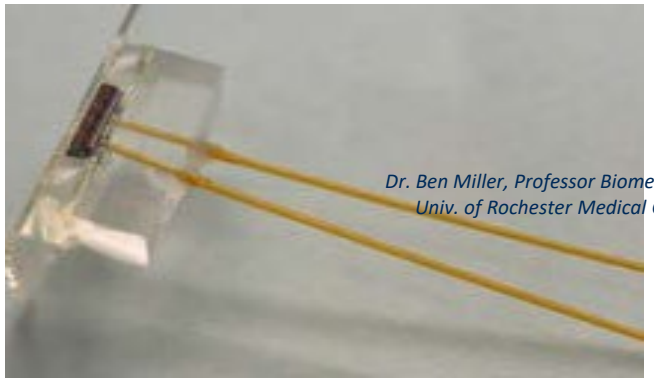
- **Communications:** Data-center, RF transceiver, chip-to-chip
- **Sensing:** LIDAR, PNT, ultra-sensitive detectors for industry, basic science, security, medical diagnostics
- **Computing:** Matrix algebra accelerators, neural networks, quantum information processing



Photon qubit source fab'ed by AIM for AFRL

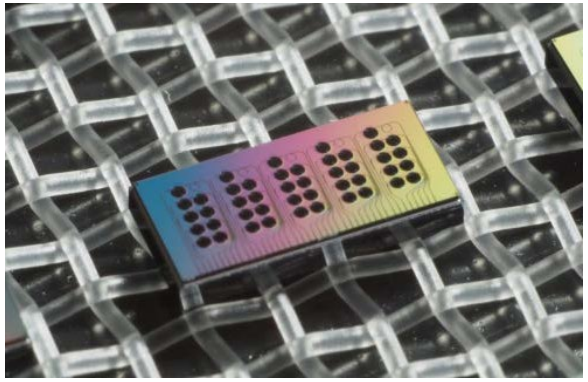


*Nature **556** (2018)*



Dr. Ben Miller, Professor Biomedical Eng, Univ. of Rochester Medical Center

URMC disposable biosensor fabricated by AIM



PIC Microfluidic chip

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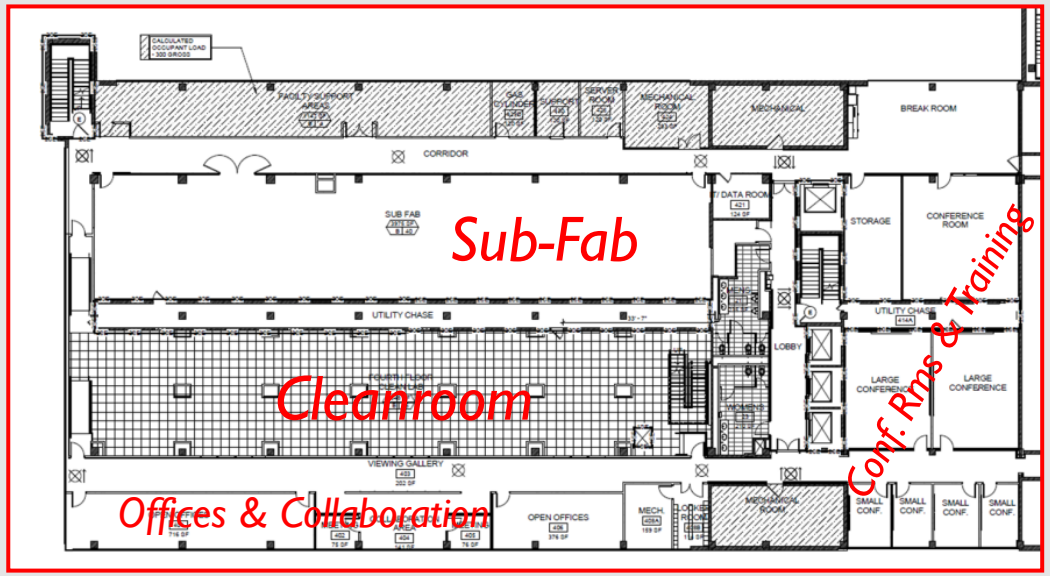
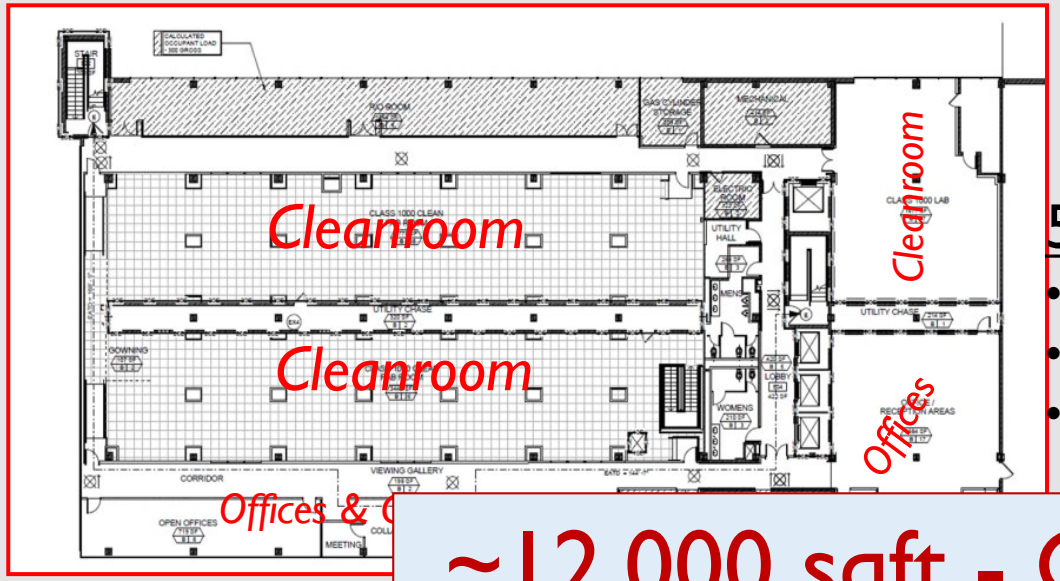
Integrated Photonics & Microelectronics Facility



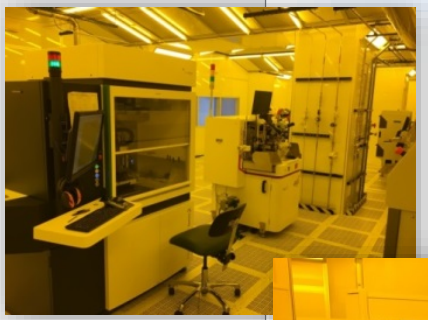
4th Floor

- *Lab*
- *Sub-Fab*
- *Cleanroom*
- *Offices/Conf Rms*



5th Floor

- *Clean Rooms*
- *Lab*
- *Offices/Conf Rms*



~12,000 sqft - Class 1000 Cleanrooms

Example of Capabilities

- Fiber Attach
  - *Single Mode Fiber*
  - *Single Fiber, Fiber arrays, PM Fiber*
  - *Active alignment*
- Flip Chip (photonic & electronic)
  - *Thermal*
    - *Sonic*
    - *Compression*
  - *Placement w/i 0.5um tolerance*
- Wafer Probing
  - *Optical/RF/DC*
- Dicing
  - *Std thickness wafers 775um*
  - *Thin wafers ~ 100um*
  - *Dicing street*
    - *≥ 100um mechanical*
    - *~ 10 - 15um Plasma & Laser*
- Die Attach
  - *Conductive and/or non-conductive adhesives*
- Wire Bonding
  - *~ 100um pitch w/ 1 mil wire*
  - *~ 150um pitch w/ 2mil wire*
- Metallization
  - *Plating*
    - *Cu, SnAg, Pd, Ni, Au*
  - *Sputtering*
    - *Ti, TiW, Cu, NiV, Ni*
- Bumping
  - *Depends on aspect ratio*
    - *> 75um pitch*
    - *< 75um pitch (on the roadmap)*
- Metrology
  - *Microscopy, Spectroscopy, Profilometry*
  - *SEM, X-Ray, IR, Acoustic, BERT*

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Ideation to Commercial Scale Including Economic Development

Spring, 2021

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New Model for Economic Growth Engine

Partnerships

Government

Industry

Academia

Enabled Region

R&D Capacity

Workforce & Education

Economic Competitiveness

Emerging Technology Industry Cluster

RF SUNY/NY CREATES Proprietary and Confidential

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North America
- Upstate NY/ New England
- Texas Metroplex
- N. California
- New Mexico
- Arizona
- Northern Oregon
- Texas Austin
- Idaho/Utah

Europe
- Ireland
- France/Grenoble*
- Benelux
- Saxony/Dresden*
- Sicily/Catania

Asia
- Japan
- Singapore
- Korea
- Taiwan
- China

Other
- Australia
- Israel

RF SUNY/NY CREATES Proprietary and Confidential

Empire Research Alliance

- NY CREATES
- U Rochester
- RIT
- Cornell U
- RPI
- Clarkson U
- Colombia U
- Buffalo U
- SUNY SB
- Binghamton U
- SUNY POLY
- Syracuse U
- AFRL Rome NY
- Brookhaven National Lab

Workforce Development Plan for Action

Nationally Partner with SEMI to enable “SEMI Works”

Within NYS Partner with:

- SUNY office of Community Colleges
- NEATEC at SUNY Poly Institute
- Workforce Development Institute (https://wdiny.org/)
- Research University Network
- Existing Regional STEM Networks
- Primary Industry Stakeholders

To Effect:

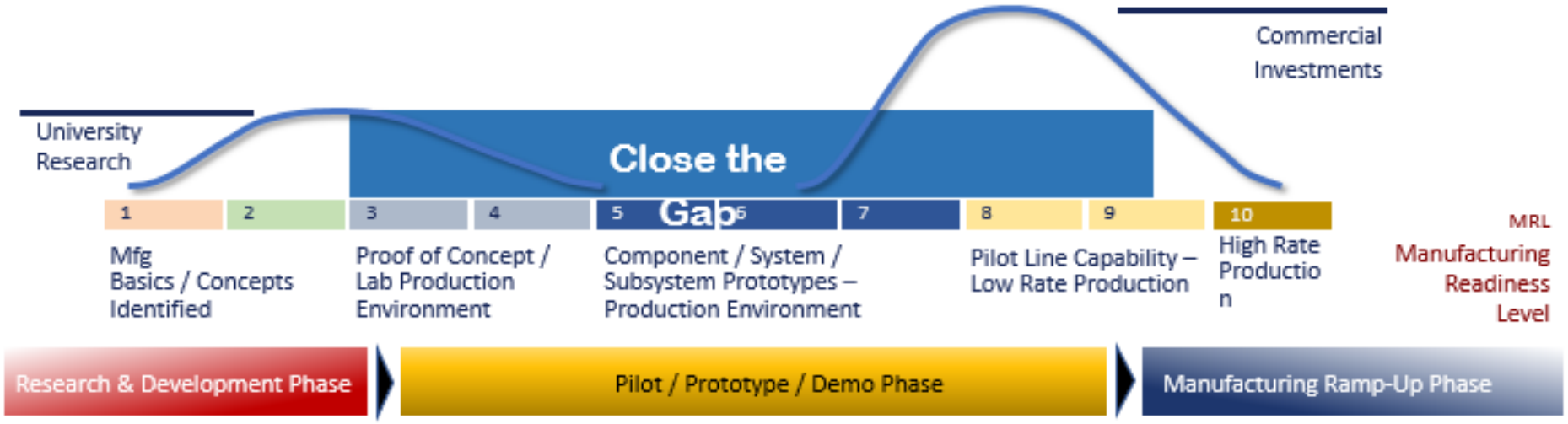
- A one stop shop virtual “Future Workers Exchange” for employers
- Enhanced training facilities for Mechatronics, Thin Film Processing and Characterization/Metrology
- Standardized Curriculum for Credit and non-credit Programs
- STEM pipeline from P-Tech HS, Traditional HS etc.
- A priority to focus on Inclusion, Diversity, Equity and Access across all efforts

To Realize better Educated & Specifically Trained Workforce in far Greater Numbers

- Structure program for easy propagation to Regional STEM hubs across US

Advanced Electronics Commercialization Continuum

DoD & ESD investment focus



DoD/AIM focus

- University Ideation >> SBIR/STTR >> Early-stage: seed/angel
- Integrated Photonics MPW >> Private Wafer >> Custom Wafer
- MRL 1-7, incubation of future SME's

ESD focus

- Funding: POCC's > Innovation Hotspots > Startup NY
- SME Workforce Development & Job Creation
- MRL 4-10 later-stage companies, not just I-Photonics
- Capital Finance & Grants for Level MRL 9-10

Corporate Venture Exchange (CVE)

The mission for the CVE, a new initiative started in 2019, is three-fold:

- Accelerate Technology Commercialization!
- Introduce early-stage technology companies in the Advanced Electronics space to equity funding sources
- Facilitate relationships between Regional Innovation Ecosystem members in Northeast to large corporate venture organizations operating in the advanced electronics arena

Target companies are Advanced Electronics driven (*Smart grid, Medical devices, Autonomous operations, Advanced communications, Sensor arrays, AI device technologies, Edge computing apps, Fabless IC companies, defense technologies, etc.*)

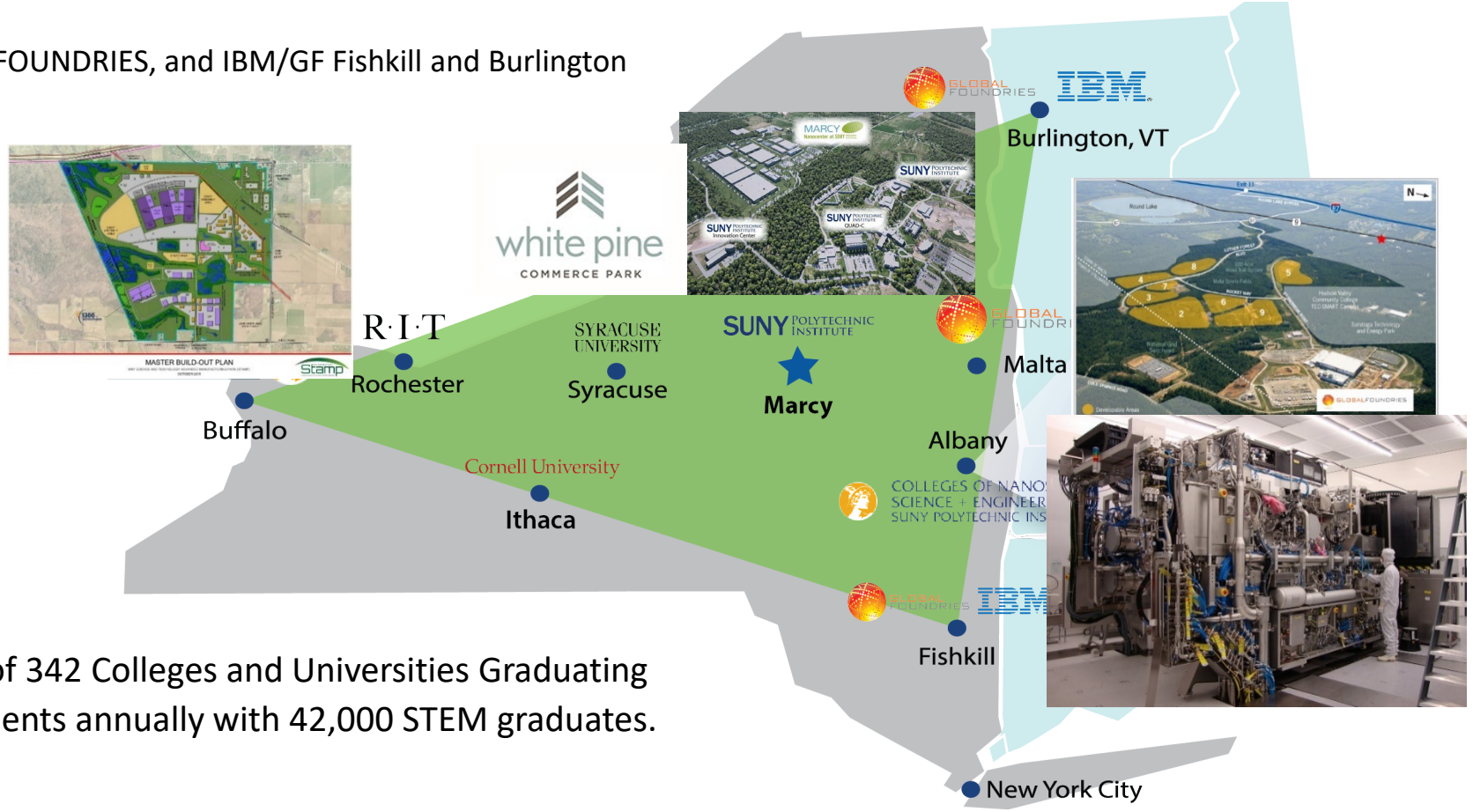
Results from the 1st CVE held at Albany on Oct 15-16, 2019:

- Applied Ventures, Intel Capital (virtual), TEL Ventures, Lam Capital, National Grid Invest, NYS Innovation Fund
- Target investment $2M-$100M
- 23 Companies participated
- 26 follow-on meetings to date

- 2021 CVE program has added 5 corporate venture organizations, with webinars and a live CVE planned in 4th Qtr. 2021.
  - LaMar Hill, President's Office, NY CREATES (lhill@ny-creates.org)

Spreading the Cluster Across NY with 4 Mega Sites

- **Workforce Development**
- Local and national college programs
- **Proximity**
- Close to CNSE, GLOBALFOUNDRIES, and IBM/GF Fishkill and Burlington



- **Education**
- High concentration of 342 Colleges and Universities Graduating 246,000 students annually with 42,000 STEM graduates.

Case Study at Luther Forest-Global Foundries

- **Investment to Date:**
- GLOBALFOUNDRIES- $15 billion
  NYS- $3.2 billion
- **Direct Jobs: 3,500** Payroll in Sept. 2020
- **Support Jobs: 16,000**
- **Annual Econ. Impact: $3.2 B**
- **Staff Profile:**
- 40 different countries
- 60% of new hires have come NYS
- 70% of employees live in Saratoga County

Workforce Profile: Average Annual Salary of Workforce $92K

- 40% Technicians and Operators (no degree or 2-year degree, avg. salary $45K)
- 50% Engineers and Scientists (min. of a bachelor's degree, avg. salary $90K)
- 10% Business Support (min. of a bachelor's degree, avg. salary Admin. $140K)

Case Study at Marcy NanoCenter-CREE Wolfspeed

- NYS & Local Gov'ts committing $640M of Total project $1.7B
- CREE commits to 620 direct jobs for Fab 1
- Ready for Equipment May 2021
- First Ramp 1st Qtr 2022
- CREE is expanding it's order base dramatically.
- CREE only uses >30% of Buildable Footprint

NY CREATES: A Global Resource

- We have flexible engagement models
- We have a strong network of collaborators
- We have access to resources
- Come and work with us!

LaMar Hill President's Office lhill@sunypoly.edu

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