



COLLEGE OF NANOSCALE
SCIENCE & ENGINEERING

UNIVERSITY AT ALBANY State University of New York

“Measuring Economic Impact of Nanotechnology in Electronics – The New York State Investment Strategy”

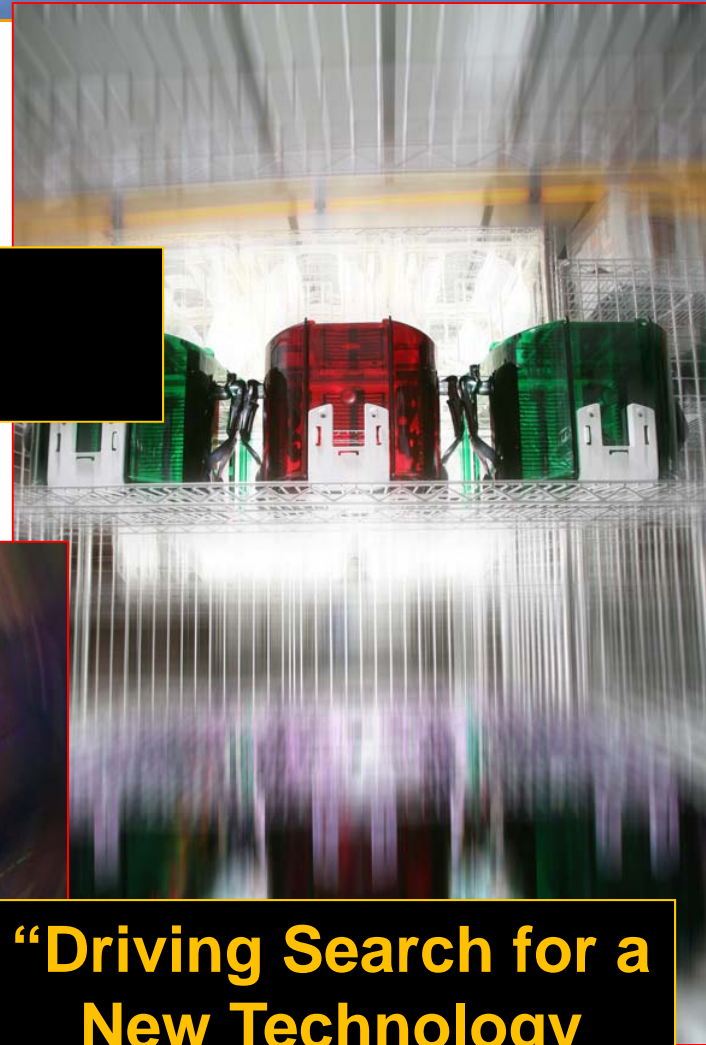
**Ji Ung Lee, Ph.D.
Professor Nanoscale Science
Director, Institute for Nanoelectronics Discovery and Exploration
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- **Changing Nature of Innovation: “Driving the Search for a New Technology Development Paradigm”**
- **Case-In-Point: “New York State Investment Strategy”**
- **Measuring Technology Inputs & Economic Outcomes: “In Search for a New Economic Impact Model”**
- **Concluding Thoughts: “Measuring Technology Clusters”**





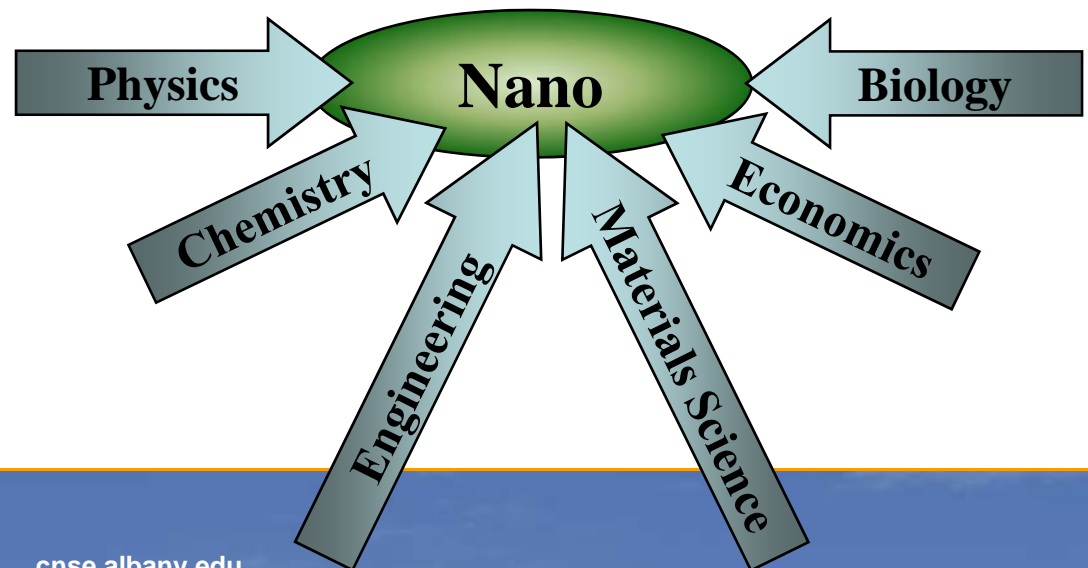
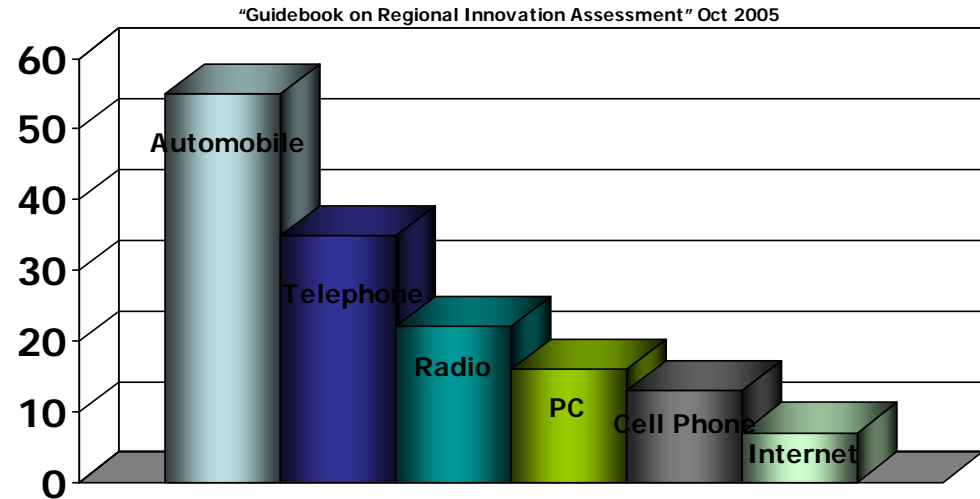
Changing Nature of Innovation:



**“Driving Search for a
New Technology
Development
Paradigm”**

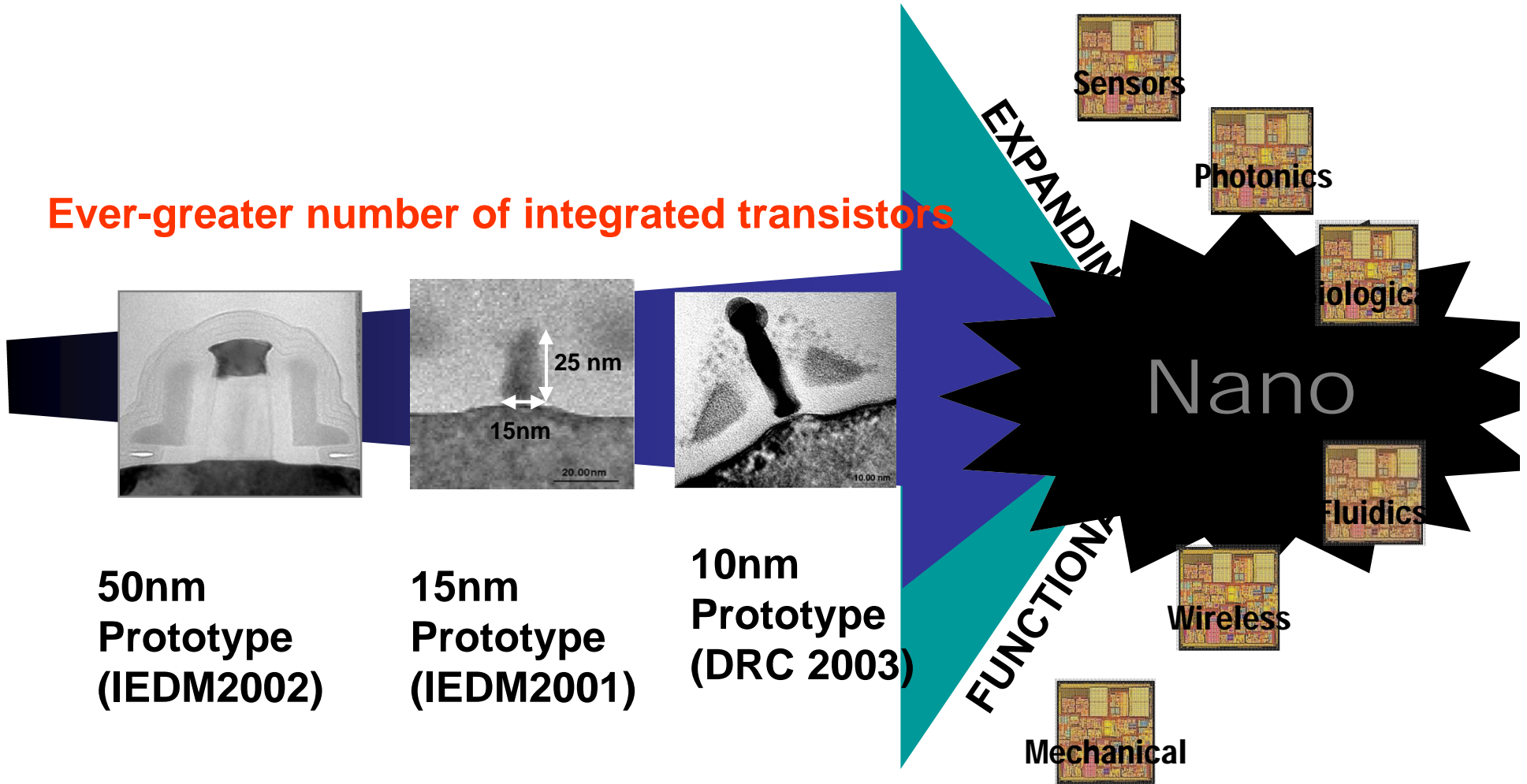
- **Faster**
 - **Collaborative**
 - **Democratized**
 - **Global**
- **Fundamentally different phenomena at Nanoscale**
- **Increased surface-to-volume ratio**
 - **Quantum effects**

Time in years to spread to ¼ of the Country



Drives Next Industrial Revolution

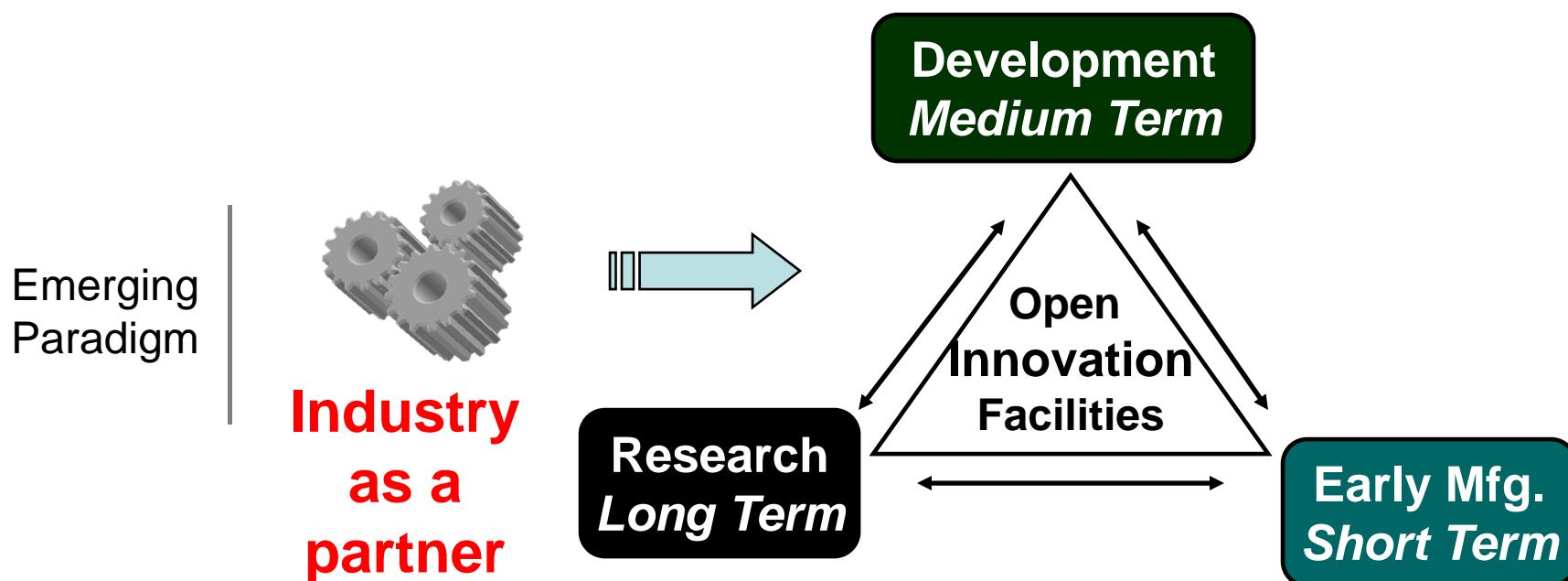
Ever-greater number of integrated transistors

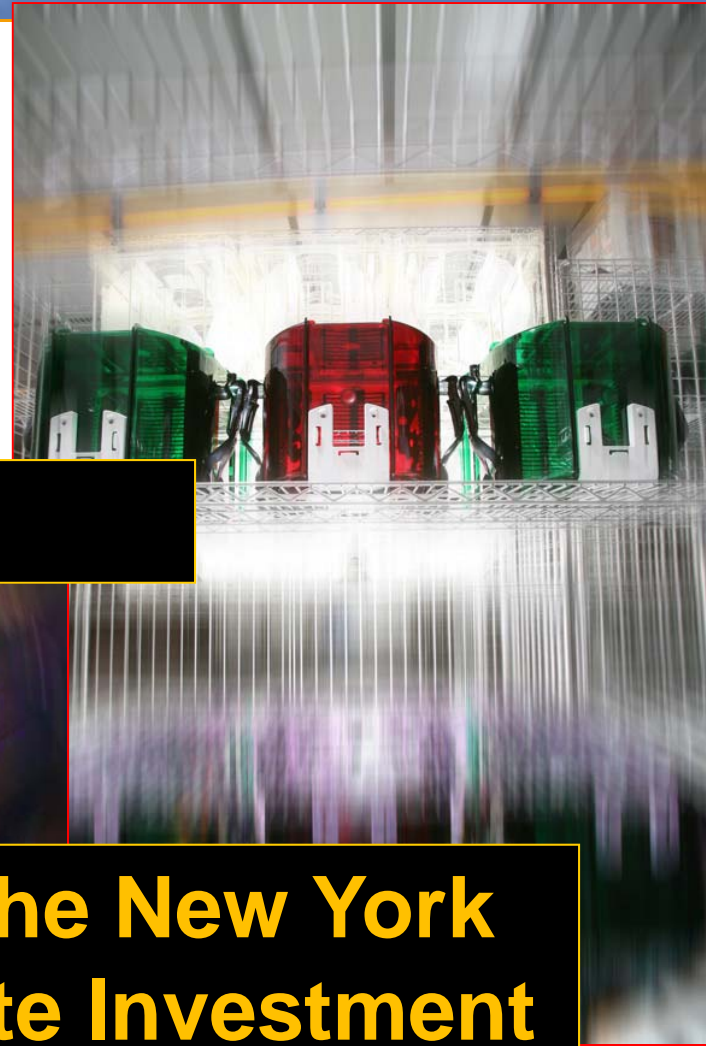


Silicon manufacturing infrastructure will enable innovation

New Technology Development Paradigm

Nanotechnology requires a closer coupling between R & D and Manufacturing driving a new paradigm in I-U-G partnership

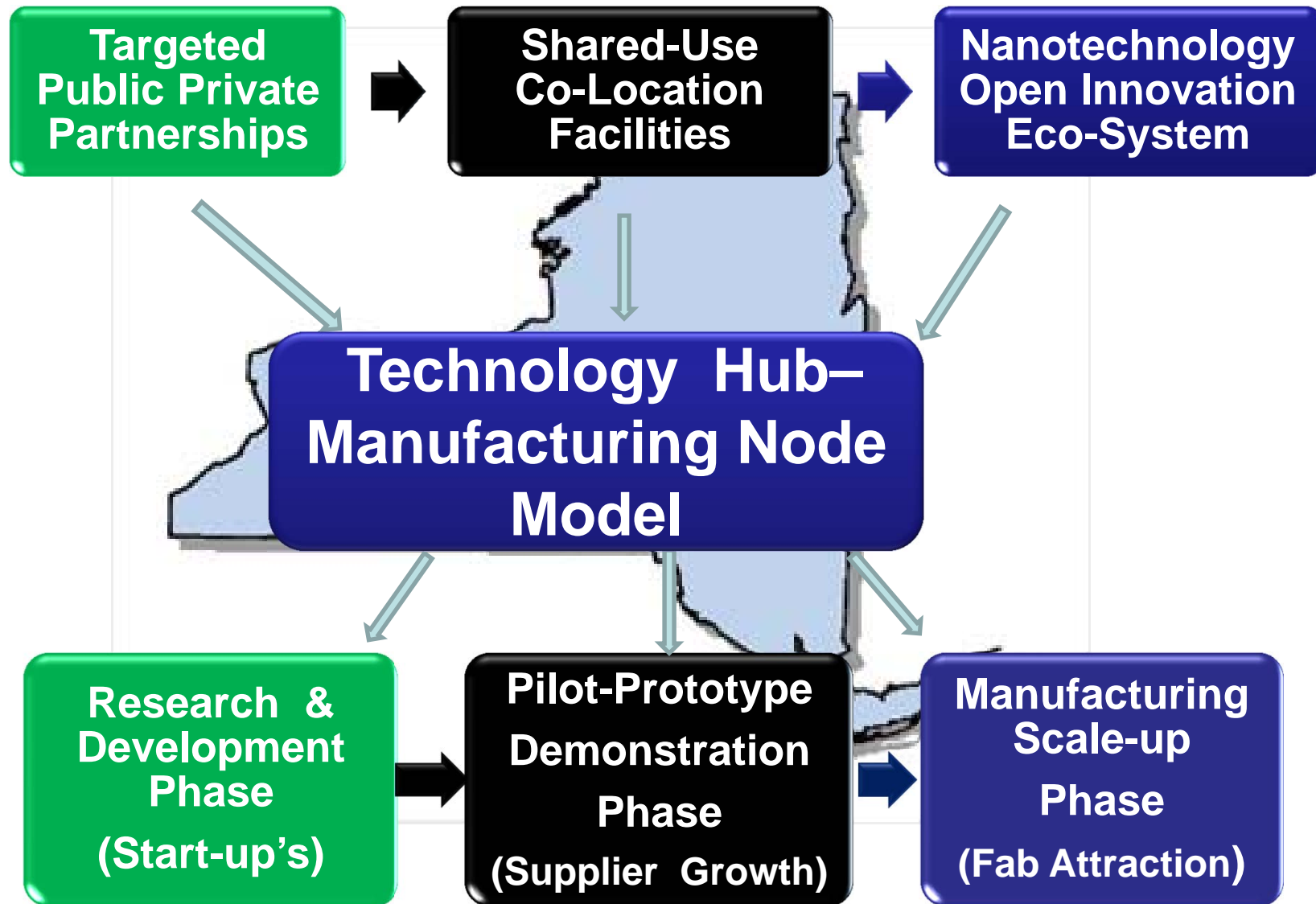




Case-In-Point

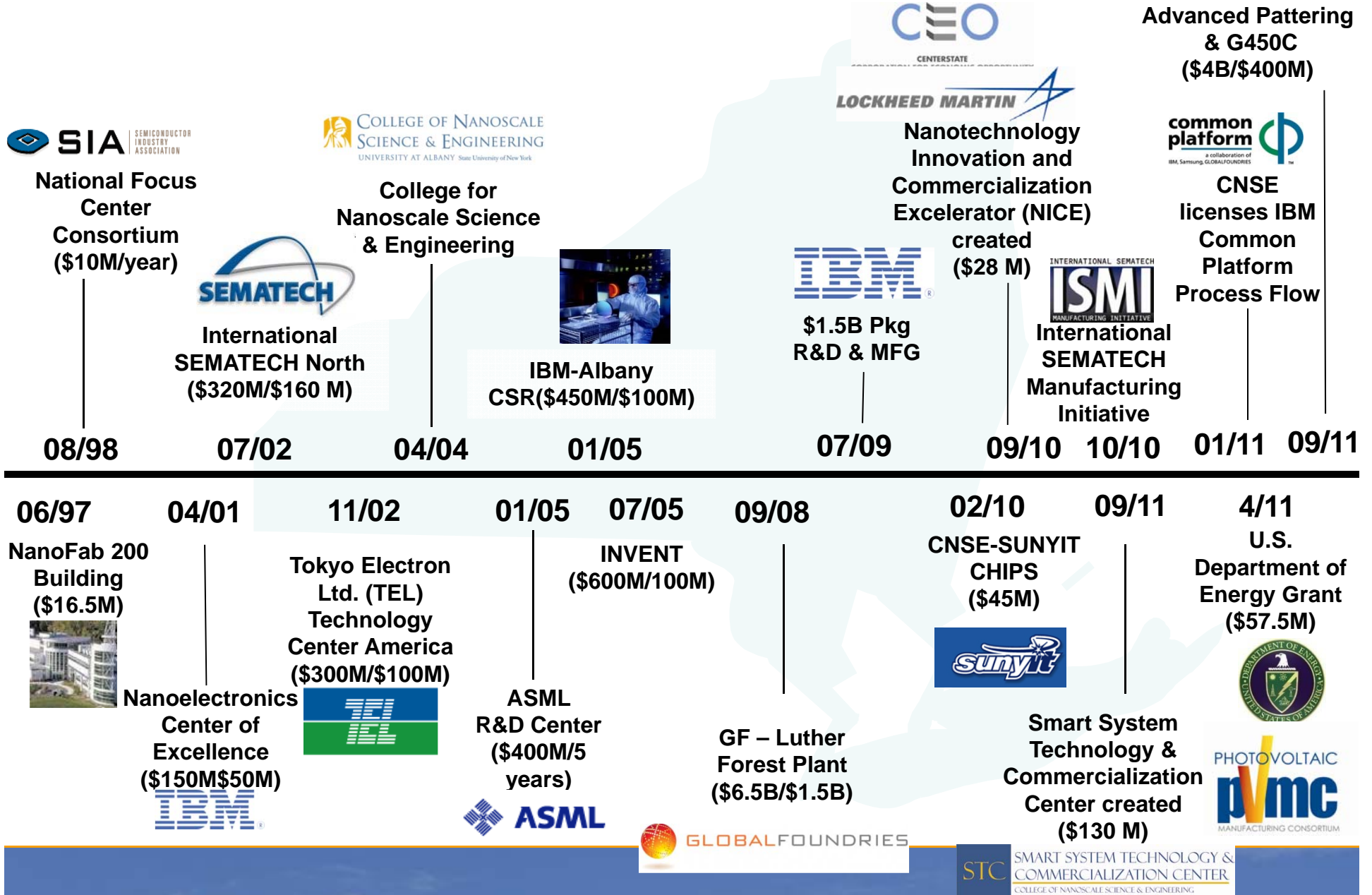


**“The New York
State Investment
Strategy”**



Targeted Outcomes

P3 Timeline: 1997-Present





Shared-Use Facilities

NanoFab South

- 32K ft² Cleanroom
- Completed: 3/04

NanoFab North/Central

- 52K ft² Cleanroom
- Completed: 8/09

NanoFab East

- 250K / 15K ft² Lab
- Completed: 3/09

NanoFab 200

- 4K ft² Cleanroom
- Completed: 6/97



Phase II Hub Expansions

NanoFab X

- **50+K ft² Cleanroom**
- **Completion: 3Q12**

G450 Consortia EUV Lithography Center

III-V Silicon Photonics CIGS PVMC

STC, Rochester

- **10+K ft² Cleanroom**
- **Trusted MEMS facility**
- **Merged: 12/11**

MEMS/MOEMS Manufacturing Scale-up

III-V Compound Semiconductor Pilot-Prototype Demonstration

An Open Innovation Eco-system

Integrated Device Manufacturers



Equipment Suppliers



Materials & Site Services Partners



Emerging Technology Companies



Industry Consortia



Global 450 Consortium

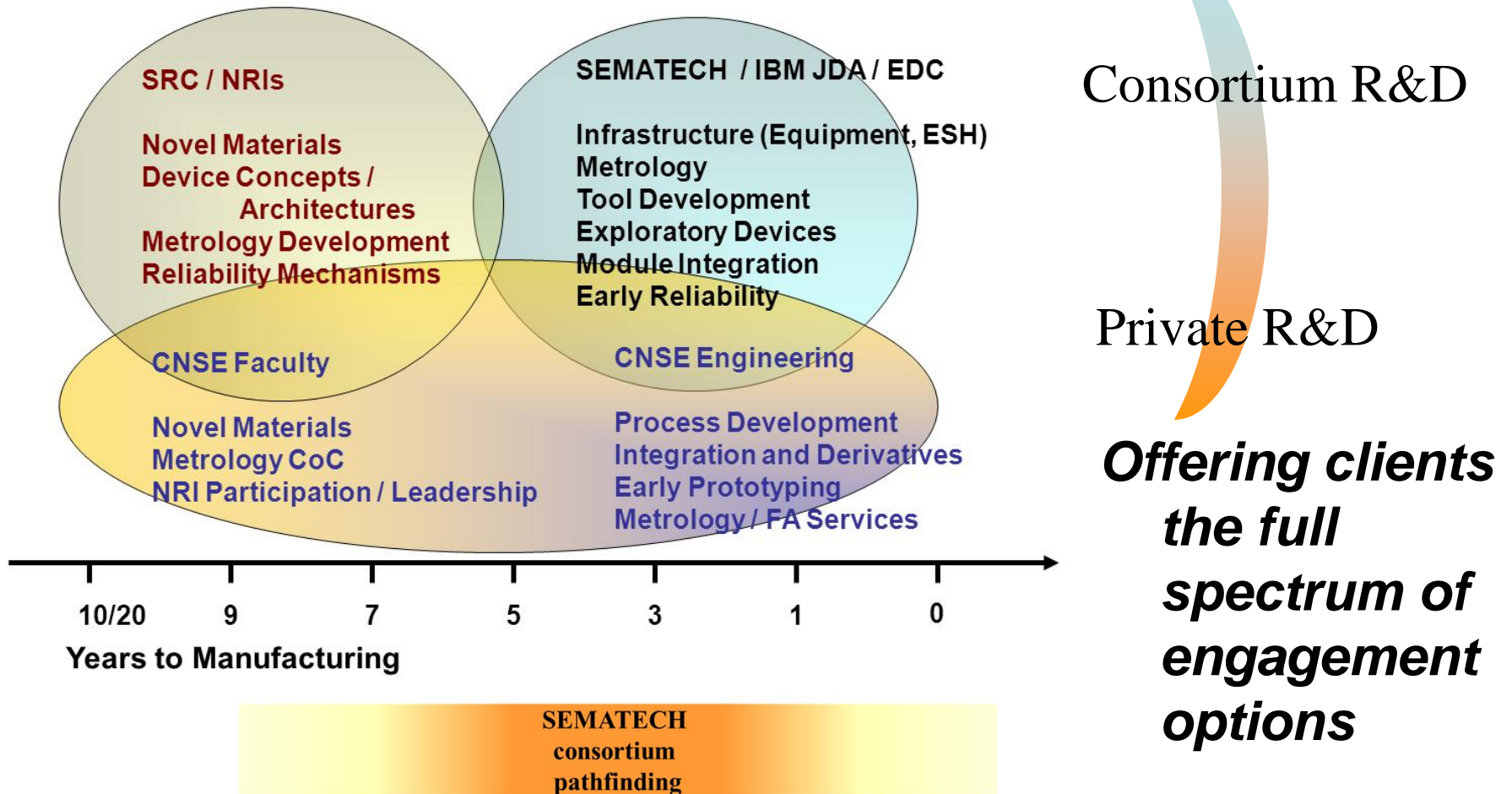
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Measuring Technology Inputs & Economic Outcomes

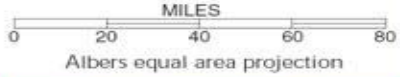


**“In Search for a
New Economic Impact
Model”**

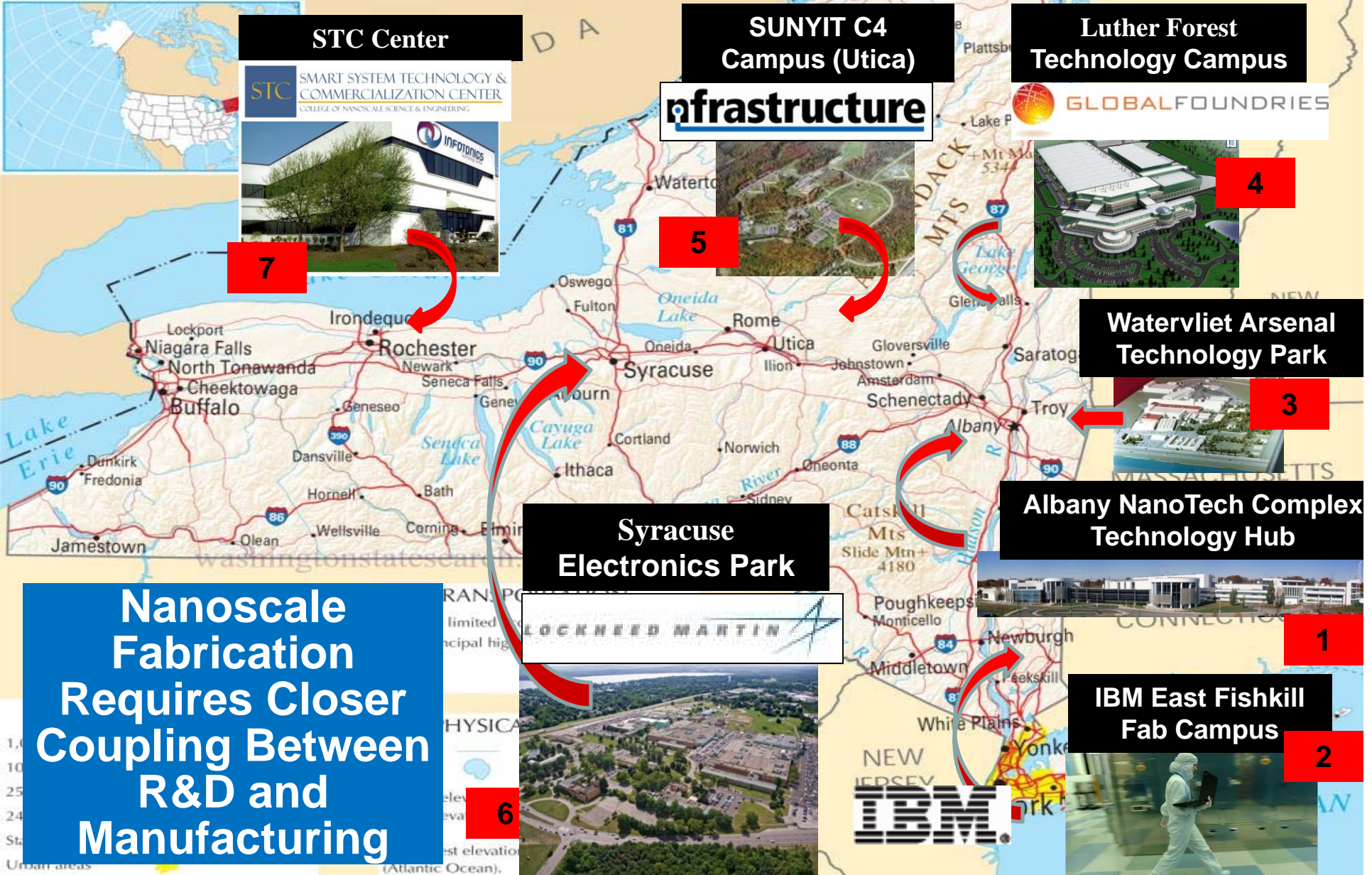
- **Shortening Development Time**
 - **Lowering Investment**
 - **Leveraging Know-how**



Enabling: Statewide Growth



New York State Map



**Nanoscale
Fabrication
Requires Closer
Coupling Between
R&D and
Manufacturing**

National Competitiveness

New York's High-Tech Corridor

New factories are part of an ambitious business-and-government effort to create a computer chip manufacturing cluster in upstate New York.



A.M.D.'s planned factory

More than \$3 billion is to be invested in a chip plant.

Saratoga

Albany NanoTech
Among the more than 100 companies and research organizations at the complex:

- I.B.M.
- Advanced Micro Devices
- Tokyo Electron
- Applied Materials
- ASML
- Sematech

Albany

I.B.M. plant

Partners include:

- Advanced Micro Devices
- Sony
- Toshiba
- Tokyo Electron
- ASML
- Chartered Semiconductor
- Samsung
- Infineon

Fishkill



The New York Times

“Global Foundries announces in October 2008 construction of \$6.5 B 300mm chip plant in Saratoga as largest industrial project in US for yr.”

“IBM announces July 15, 2008 a \$1.7B expansion in 300mm chip research & manufacturing facilities.”

In-Sourcing of Critical Technology

Waterveleit Arsenal

OEM, ancillary equipment & support service company headquarters.

- ❑ Vistec Lithography and NYS invest over \$150 M transferring operations from Cambridge UK to Albany.
 - E-Beam R&D Center at CNSE;
 - E-Beam Manufacturing at Arsenal;
- ❑ M+W Group establish North American Headquarters & Center for Construction Trades Training
 - 200+ MEP craftsmen trained annually at Arsenal since 2004.



M+W GROUP

Workforce Development

Engagement



Nano Carrier
Day (Middle &
High School)

Ctr. Urban Youth
& Technology –
(At-Risk Students)



Enrichment

High School &
Undergraduate
Internships



Nano High
Albany City
School District

SEMI®
Workforce
Development
Institute

cnse.albany.edu

Education

World's First
NanoCollege
Ph.D., MS, BS

Partnerships with
Community
Colleges

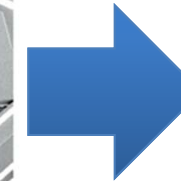
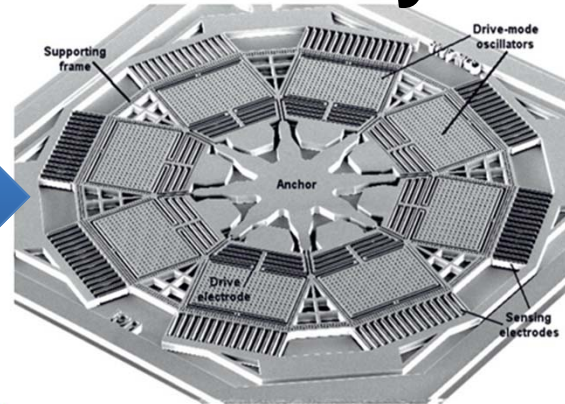
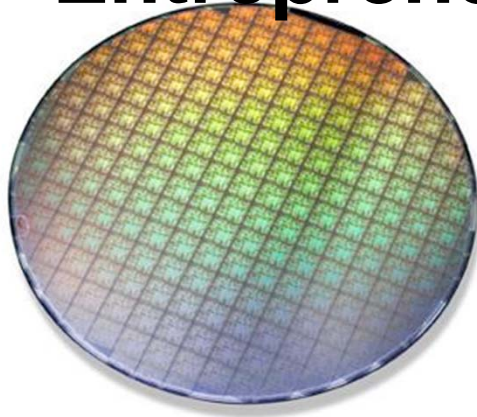
M&W Group
Center for Construction
Trades Training





Enabling:

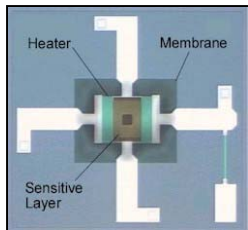
Entrepreneurial Smart Systems Revolution



Sensors

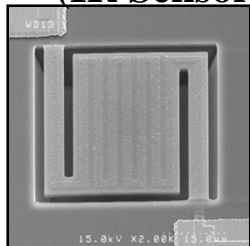


Actuators

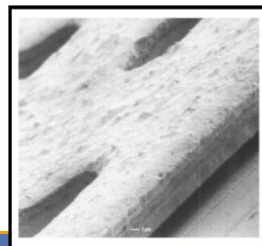


**Electronic Nose
Electronic Tongue
(Chemical Sensor)**

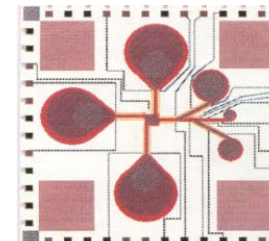
**Electronic Eye
(IR Sensor)**



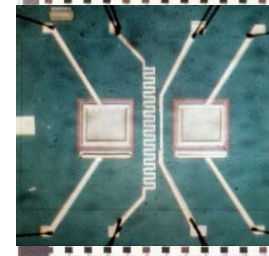
**Electronic Ear
(Si Diaphragm)**



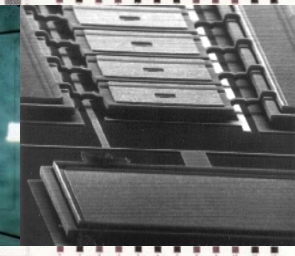
Pumps



Valves

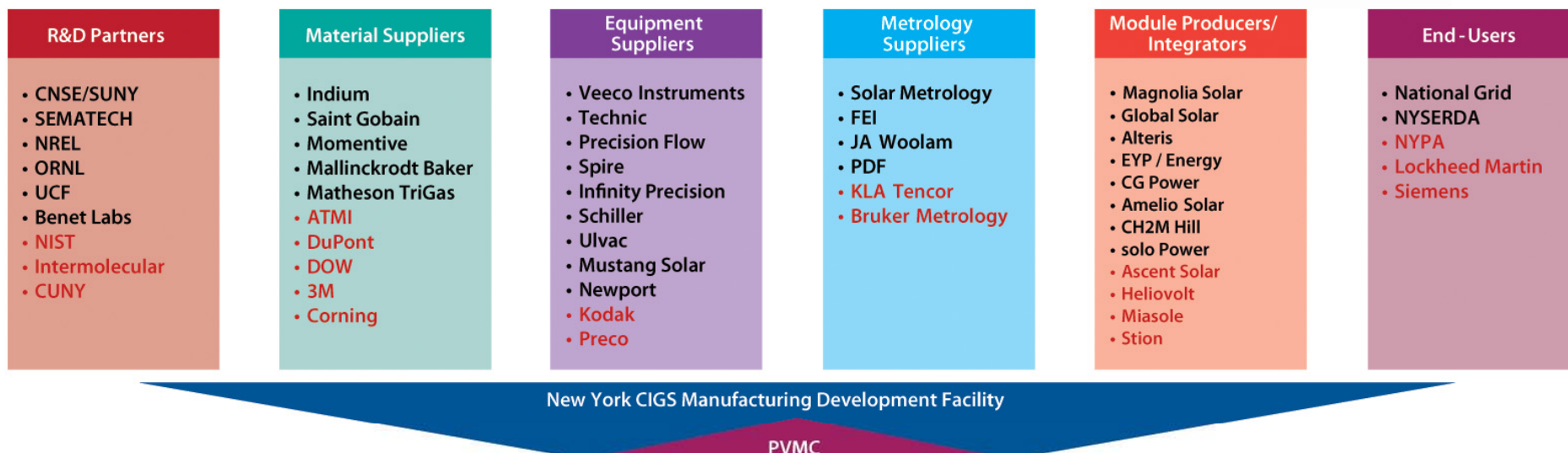


Emitters



Arrays

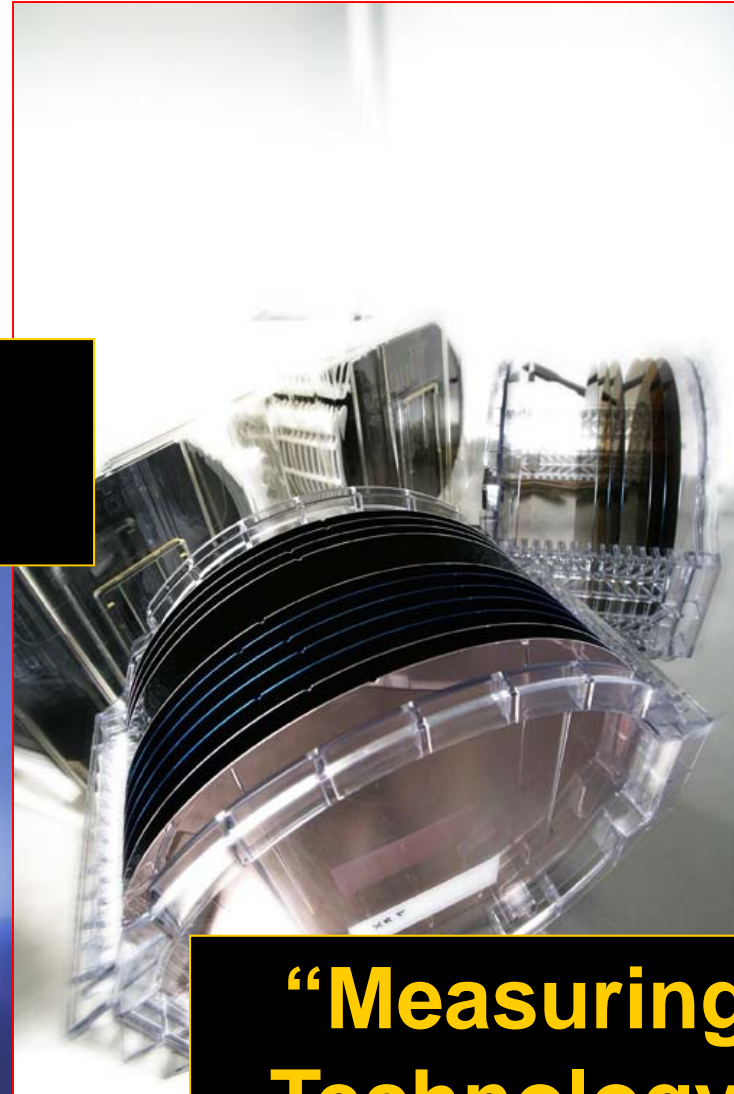
Clean Energy Manufacturing



- **CNSE received a \$57.5 million grant from the U.S. Department of Energy to help fund the creation of the U.S. Photovoltaic Manufacturing Consortium (PVMC) at CNSE's Albany NanoTech Complex**
- **CNSE researchers are working on advancing these technologies as well as on improvements on solar cell manufacturing.**



Concluding Thoughts

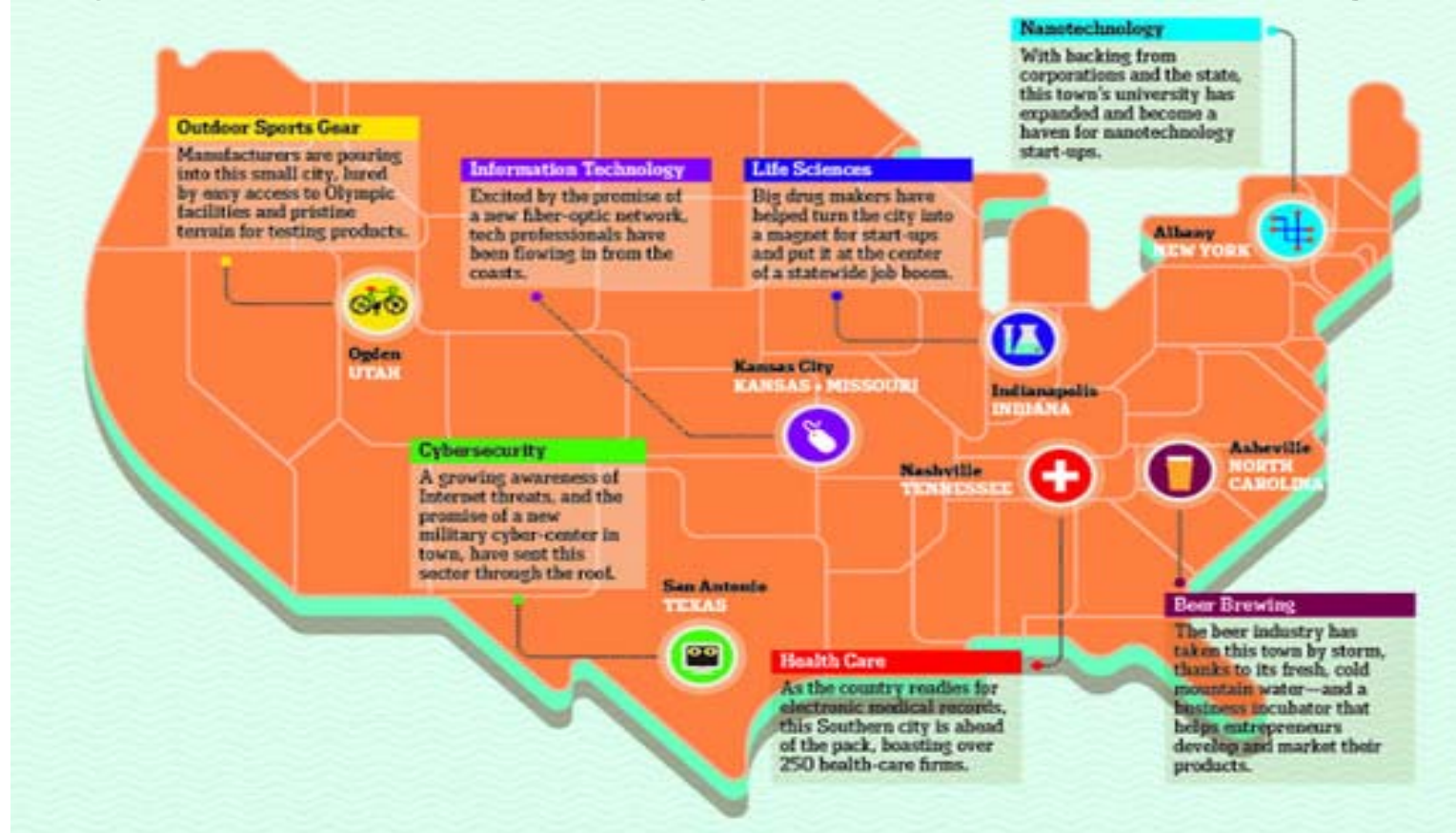


“Measuring
Technology
Clusters”



Measuring Technology Clusters

Where the Action is: Across the country, new industry hubs are drawing entrepreneurs and investors - and offering start-ups support & safety in a turbulent economy. (Wall Street Journal August 2011)



Requires New Dynamic Economic Models

CENN Economic Impact



- **300+ industry partners including electronics, energy, defense & biohealth**
- **\$14 B investments and over 2700 R&D jobs currently on site (projected increase to 3700 R&D jobs by 2014)**
- **Since 2001: 12,500 jobs created/retained; \$1B wages; \$28B investment**
- **Projected by 2015: 25,000 jobs created/retained; \$2.25B wages**