

Nanotechnology, Commercialization, and Innovation: The Case of North Carolina

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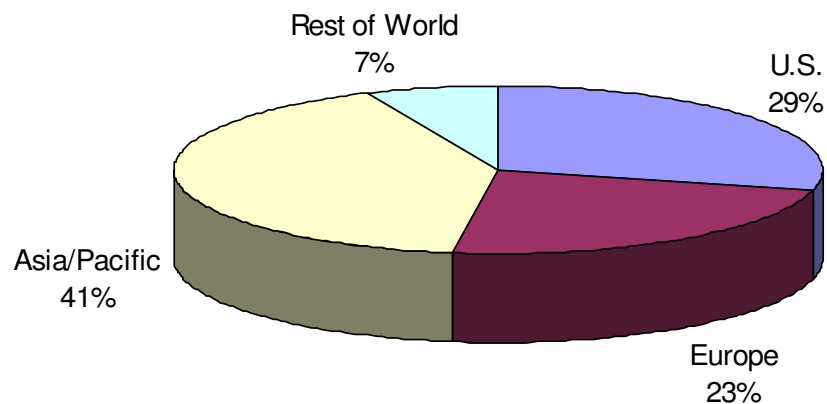
Key Topics

- I. U.S. Nanotechnology Industry
- II. NC Nanotechnology Industry
- III. Emergence of Nanotechnology in the U.S. South
- IV. Future Steps to Strengthen Nanotechnology Industry in North Carolina

Nanotechnology in the United States

- Firms:
 - US firms capture approximately 30% of total global revenue in products incorporating emerging nanotechnology

Table 1: Emerging Nanotechnology Revenues by Region, 2004



- Strengths:
 - Healthcare/life sciences
 - Electronics/IT
- Key firms:
 - Divisions of larger firms: GlaxoSmithKline, IBM, Kraft, BASF
 - Smaller firms: Nano-Tex, Liquidia, Altair Nanotechnologies

Nanotechnology in the United States

- Financing:
 - Federal government (National Nanotechnology Initiative/NNI): \$1.4 billion (2006), expanding to \$1.5 billion by 2008
 - State/local government: \$430 million (2006)
 - Private sector spending: \$1.9 billion (2006)
- Patents/IP:
 - 43,000 patents since 1995 (more than 18,000 patents ahead of second-place China).
 - 6,801 international patents in 2006 (nearly 70% of the total)

NC Nanotechnology Industry Facts

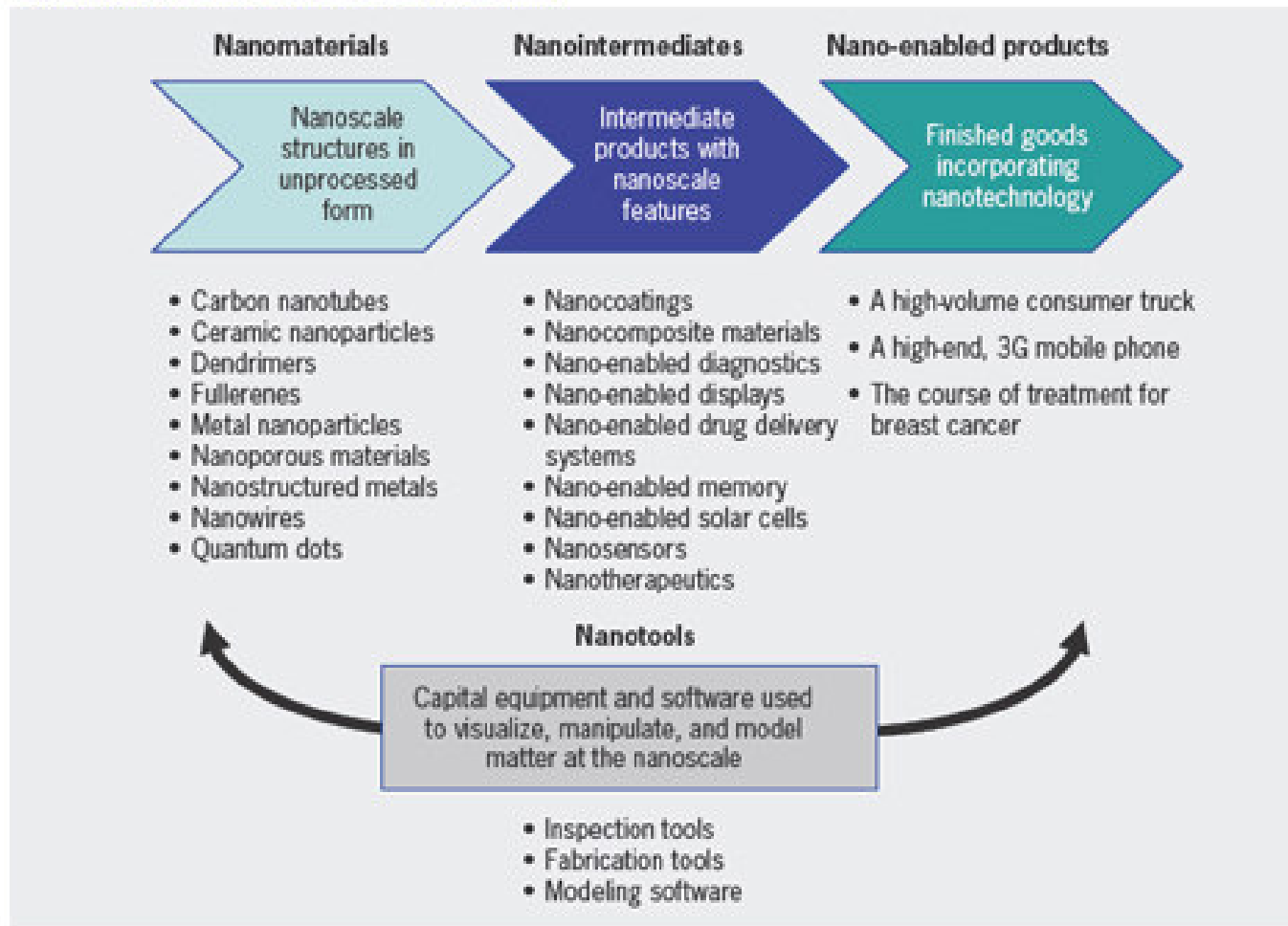
- Small Times (2005) ranked NC in the top 10 regions in the US for nanotech research
- NCSU & UNC-CH ranked in top 10 in industrial outreach in nanotechnology
- NCSU, UNC-CH, and Duke rank in top 100 institutions nationwide based on total funding awarded in nanotechnology
- Between 1995-2004, the NSF awarded 139 nanotechnology grants to NC researchers
 - Funding totaled more than \$53 million
- More than 250 nanotechnology patents were issued to NC assignees between 2003-2005

What is the nature of the
nanotechnology industry in North
Carolina?

What are firms actually doing?

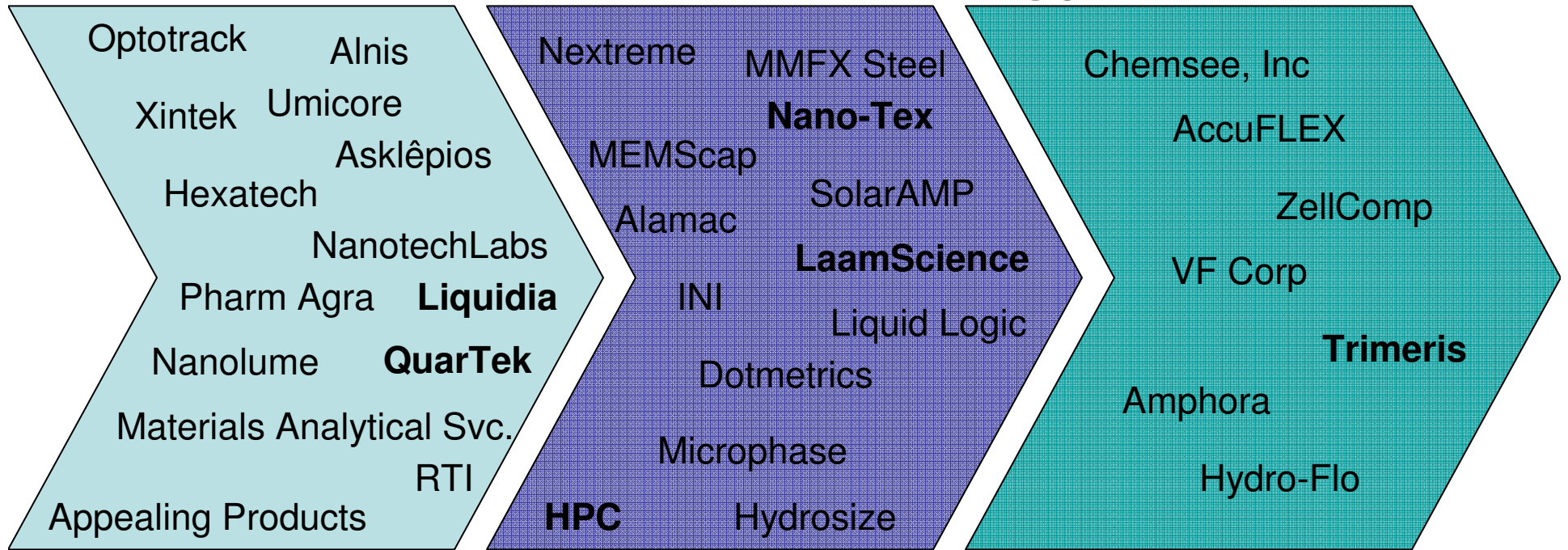
Nanotechnology Value Chain

Technologies Profiled Across the Value Chain



Source: Lux Research (2006)

North Carolina Nanotechnology Value Chain



Nanomaterials
(14)

Nanointermediates
(13)

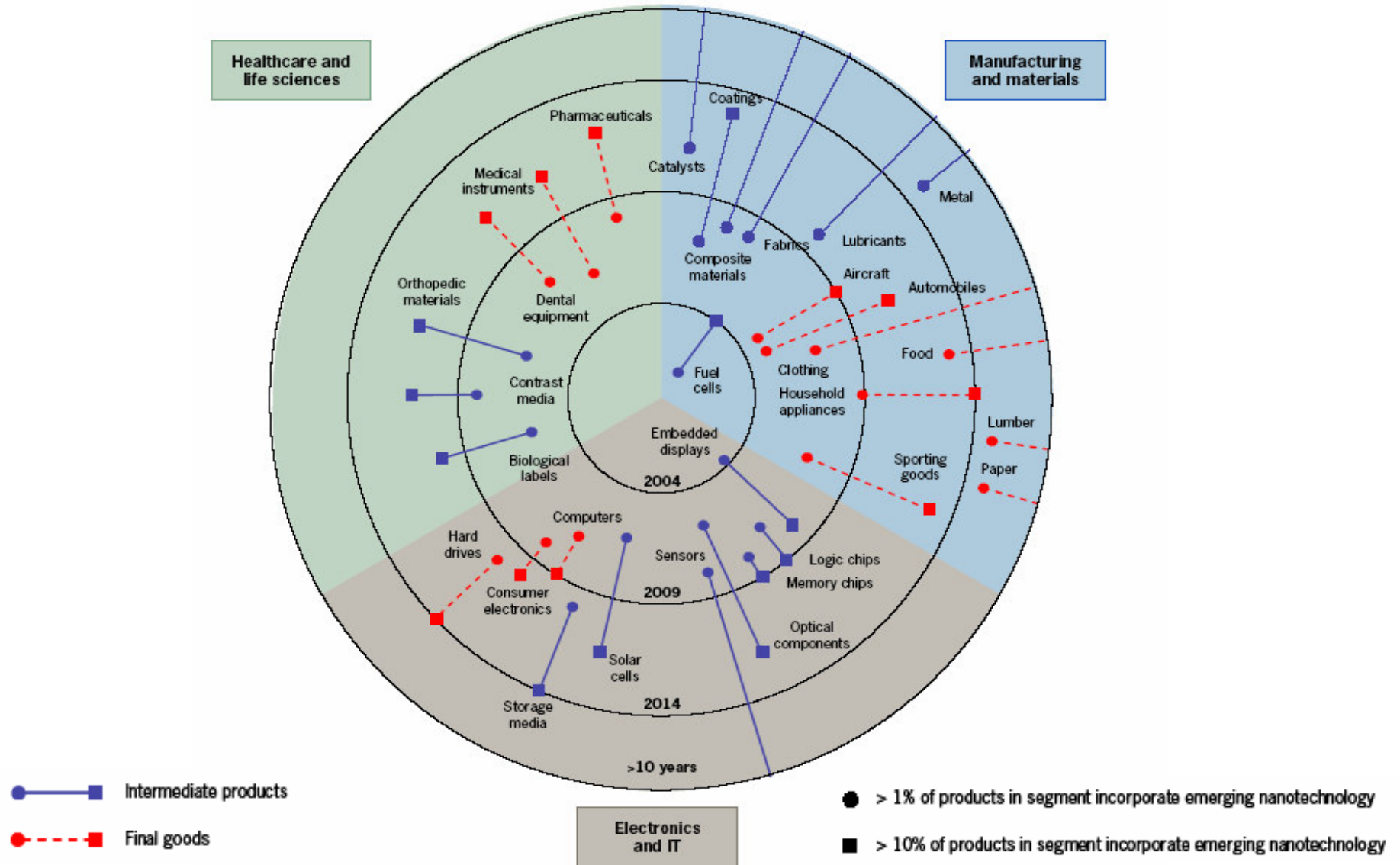
Nano-Enabled Products
(7)



Nanotools
(15)

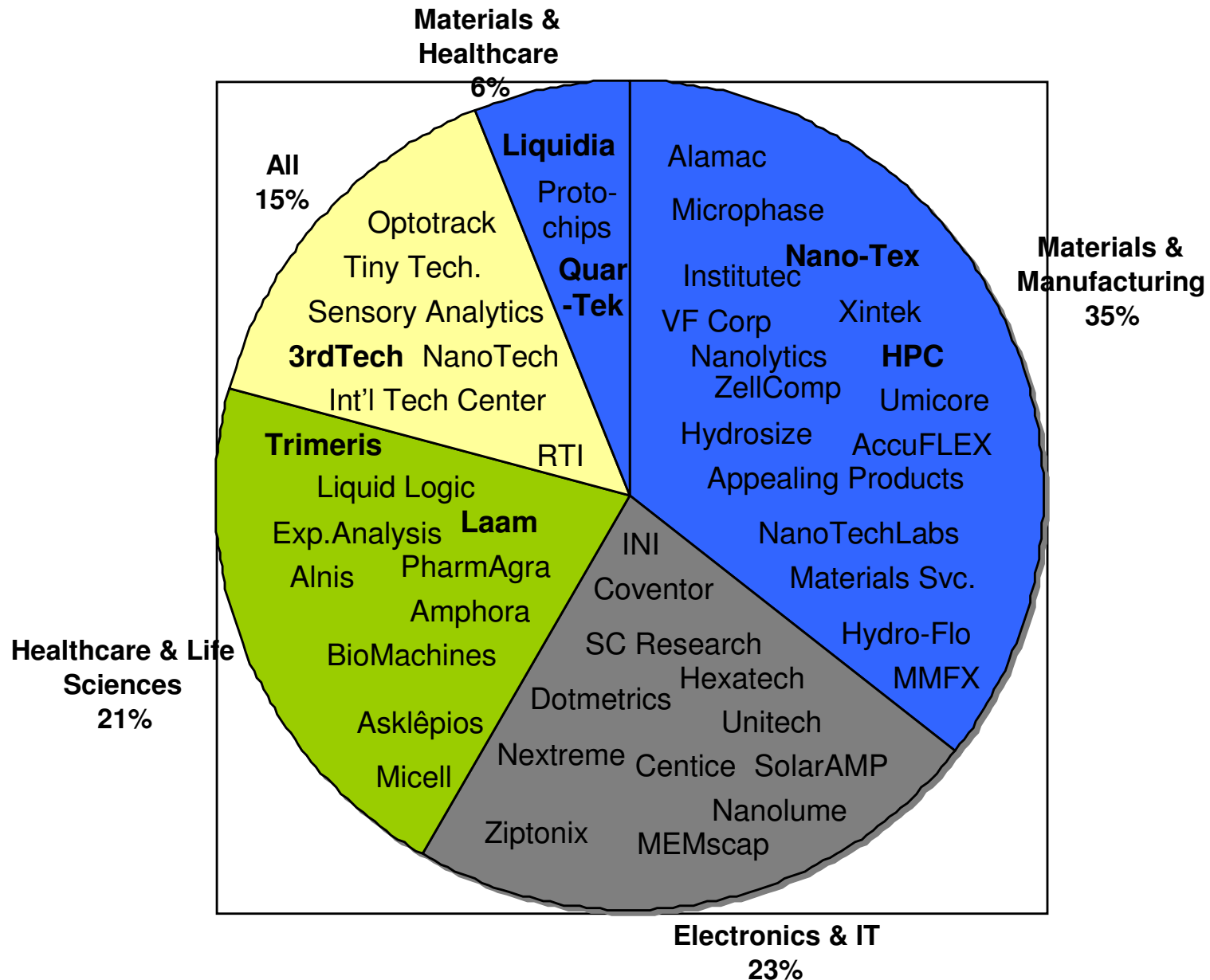
Source: Gereffi, Frederick, & Ong (2007). Nanotechnology In North Carolina Presentation

Time Horizons for Major Nanotech Industries



Source: October 2004 Lux Research Report "Sizing Nanotechnology's Value Chain"

North Carolina Nanotech Firms and Industries



Source: Gereffi, Frederick, & Ong (2007). Nanotechnology In North Carolina Presentation

Emergence of Nanotechnology in the U.S. South

- Study focused on the potential of the U.S. South (13 states) to develop a viable nanotechnology industry
- Ten indicators in four areas:
 - Knowledge generation
 - Human capital
 - R&D funding
 - Patenting

Alabama, Arkansas, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Virginia, & West Virginia

Source: Youtie & Shapira (2008). Forthcoming in The Journal of Technology Transfer

Findings:

- Overall findings: U.S. South has little potential to develop nanotechnology industry except for a few clusters:
 - Research Triangle Park, NC
 - Atlanta, Ga
 - Oak Ridge, TN
 - Virginia
- North Carolina, driven by RTP region, ranked the highest on all 10 indicators

	South (% of US)	NC	Ga	TN	Va
1. Nano Publications	5,604 (20.2%)	1,134	836	826	797
2. Institutions with 3+ primary researchers	67	10	6	6	11
3. Co-authorship linkages	33% (in U.S.) 18% (world)				
4. Highly-cited researchers	111 (18.2%)	30	24	14	11
5. Editors of nano-related journals	21 (10.3%)	5	4	1	7
6. Doctoral dissertations	577 (15.9%)	125	95	39	72
7. Prize winners in nanotechnology areas	9 (8%)	4	4	0	1
8. NSF awards	\$337.4 million (17%)	\$53.4	\$33.8	\$26.1	\$36.8
9. SBIR/STR awards	\$77.9 million (15.6%)	\$6.8	\$6.5	\$5.4	\$41.7
10. Patents	1,015 (8.5%)	214	145	120	182

Challenges and Opportunities for Nanotechnology in North Carolina

Strengths & Weaknesses of NC to form Nanotechnology Industry

Strengths

- 1) An established emphasis on enabling technology industries: biotechnology & information technology
- 2) An existing manufacturing base
- 3) Strong university infrastructure
- 4) Local support (government)

Weaknesses

- 1) Lack of strong linkages to critical US centers in California and the Northeast
- 2) Relatively weak in patenting
- 3) Not fully capitalizing access to strong research universities and centers
- 4) Smaller regional capital pools and private R&D are also limiting factors in the South

Challenges & Opportunities

- 1) Lack of access to early-stage capital, especially for companies in the research phase
 - State government could act as venture capitalists to overcome market failure in capital market
- 2) Lack of access to university equipment & facilities
 - State could provide incentives to universities through public/private centers for excellence for sharing capital equipment and facilities with nano companies
- 3) NC university nanotechnology programs do not have significant industry collaborations
 - NC A&T and nCoat, Inc. have established a technical collaboration agreement for nano-based materials

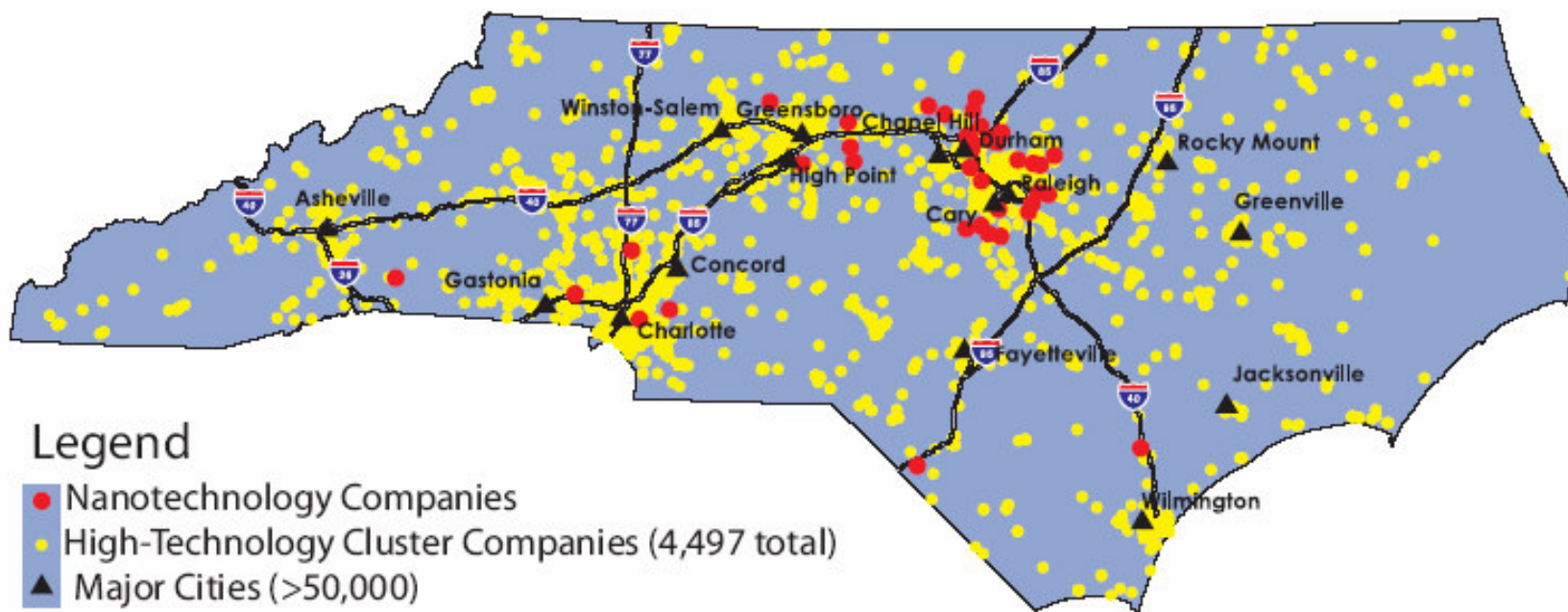
Challenges & Opportunities (cont'd)

- Develop guidelines to manage potential risks of nanotechnologies
 - Ideal research agenda for NC universities due to diversity of programs
 - DuPont and Environmental Defense have already established useful guidelines
- Build on unique combination of research universities, existing technologies, and historical dominance in manufacturing

Importance of Existing Technology

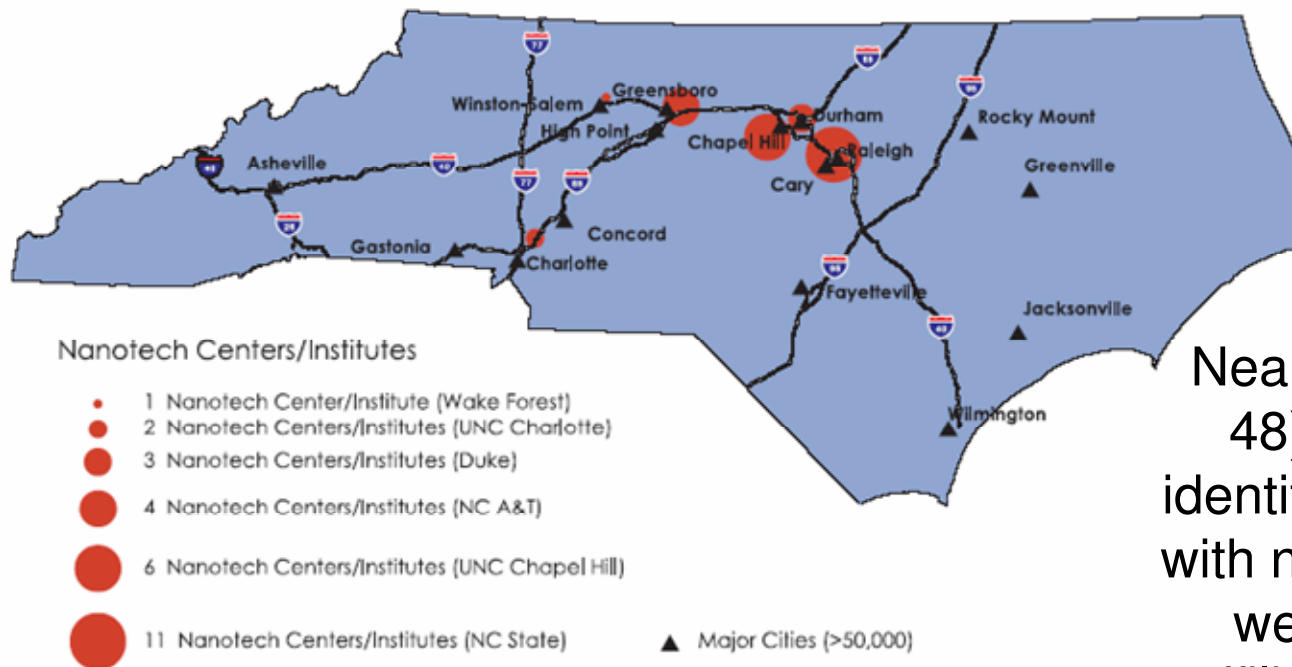
Emphasis: Existing Technology Firms

Nanotechnology Companies and
High-Technology Companies



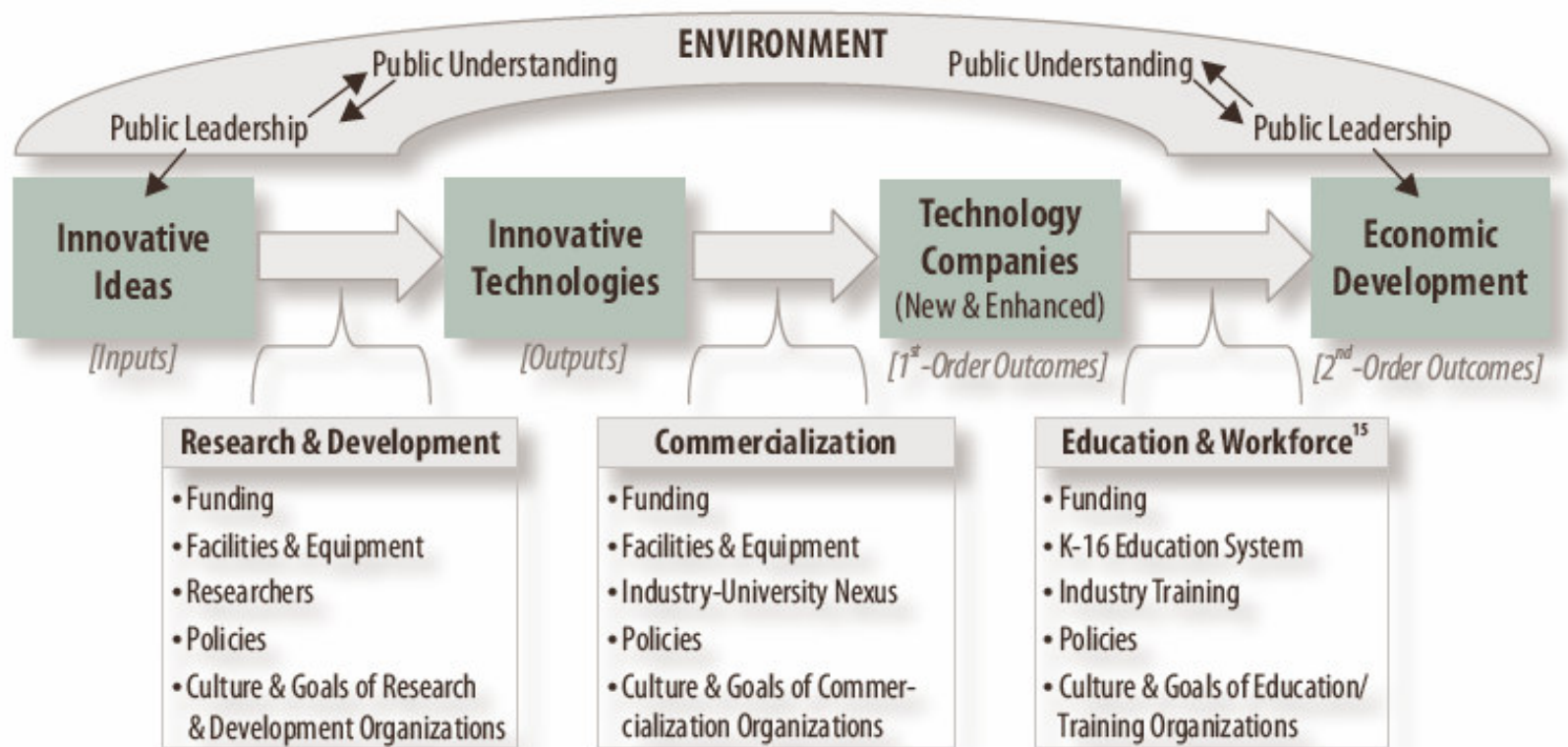
Importance of Universities/Research Centers

University Centers/Institutes Focusing on Nanotechnology in North Carolina (30 known)



Nearly 50% (23 of 48) companies identified as working with nanotechnology were originally affiliated with local universities

Policy Framework - Outlined in Roadmap: NC's Technology-Based Economic Development Approach

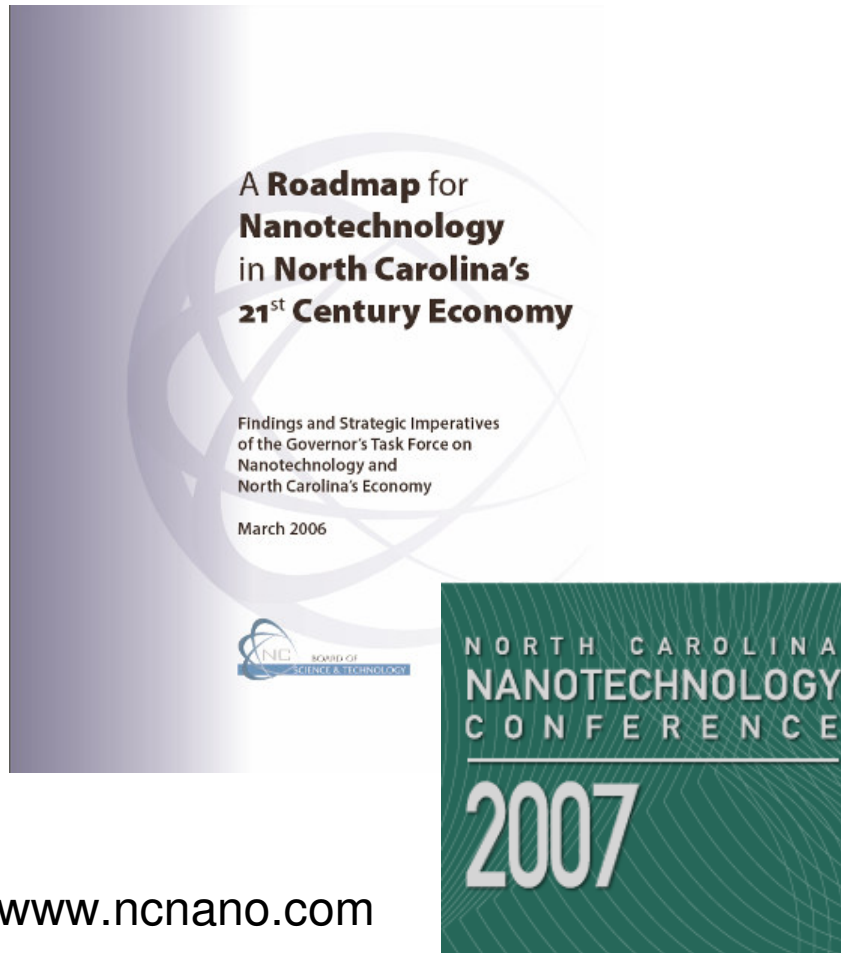


Key Elements Directed Toward Mobilizing & Equipping NC to Advance the State's Nanotechnology Economy

- 1) Establish NC Nanotechnology Alliance
- 2) Establish multiple centers of nanotechnology excellence at NC's universities based on strengths of universities
- 3) Establish a not-for-profit nanotechnology "imagineering" group staffed to identify emerging nano opportunities
- 4) Create website
- 5) Convene an annual NC Symposium on nanotechnology

- 6) Ensure nanotechnology is explicitly considered in education and workforce development
- 7) Strengthen teacher knowledge of advances in nanoscale science
- 8) Integrate info about nano into the NC Biomanufacturing and Pharmaceutical Training Consortium
- 9) Explicitly integrate the environmental, ethical, health, legal, safety, and other societal implications of nanotechnology into the public discourse
- 10) Emphasize education of policy makers, the public, the business community, and the scientific community on issues related to nanotechnology

Importance of State/Local Support



www.ncnano.com



www.ncnanotechnology.com

Thank you for your attention!