

The Nanomanufacturing Challenge



Nanomanufacturing

- Processes must work at a commercially relevant scale
- Cost is a key factor
- Must be reproducible and reliable
- EHS under control
- Nanomanufacturing includes *top-down* and *bottom-up* techniques, and integration of both
- Must form part of a value chain

Fundamental Research

Technical Research Groups

TRG 1: Nanoscale Materials & Processes
TRG 2: Nanoscale, Devices, Systems, Metrology
TRG 3: Sensors and Environmental Monitoring

Synergy & Collaboration

National Nanomanufacturing Network

Catalyst for Collaboration and Information Sharing Web
and Workshops
InterNano Digital Library & Clearinghouse

Translational Research

System-Level Process Test Beds

Identify Barriers to Implementation
Address Fundamental Research Challenges
Demonstrate Process Platform
Pursue Applications with Partners

Education & Outreach

Lesson Modules and Multimedia Content

Visual Learning Content for Education
K-12, Undergrad, Graduate, Workforce
Comprehensive Diversity Strategy

Technology Transfer

Industry Partnering

MassNanoTech Partners, sponsored research, licensing,
and company consortia

Societal Implications

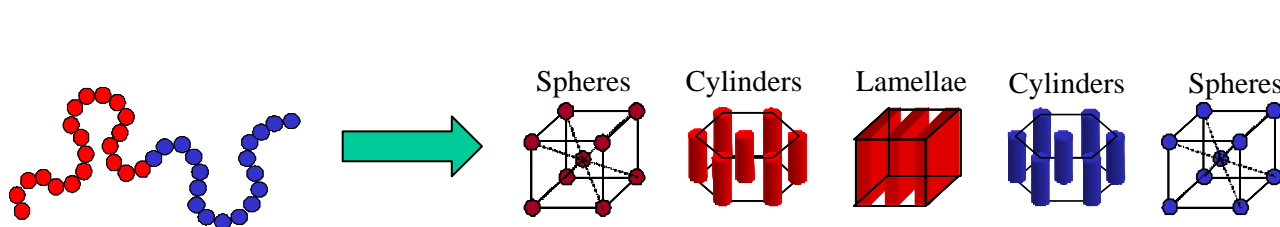
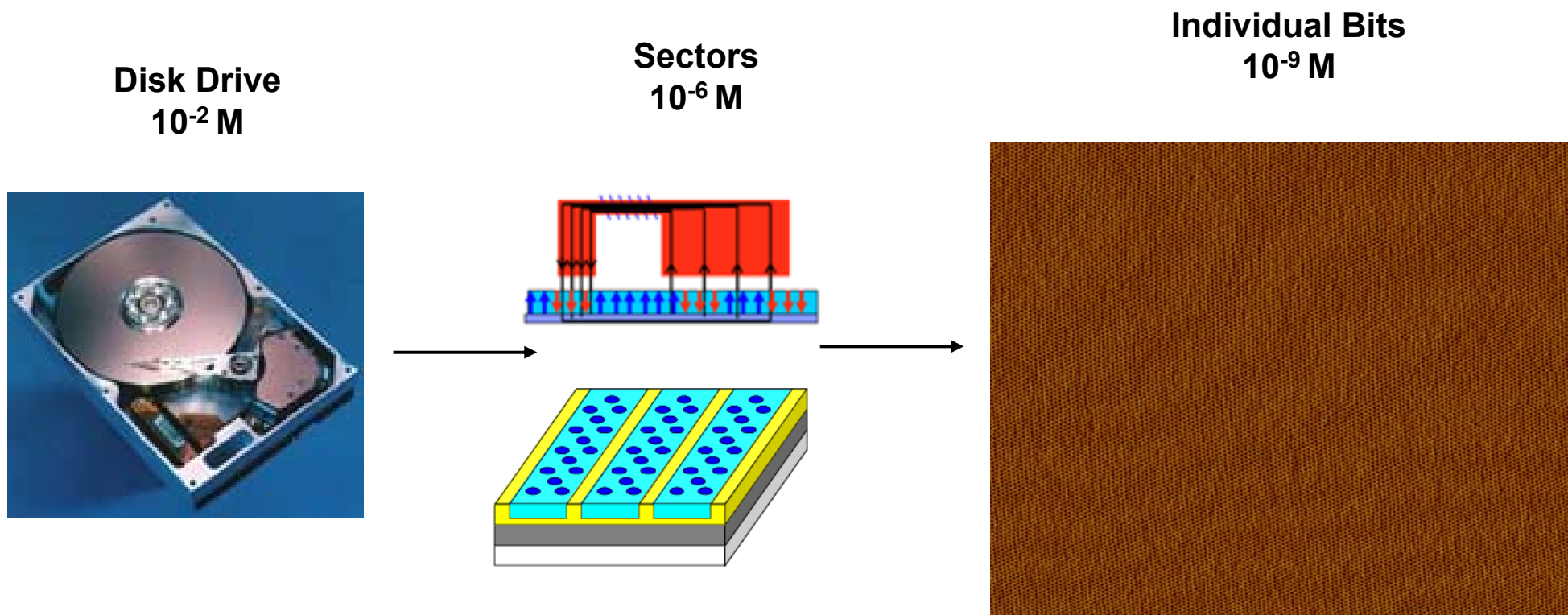
Technology and Economic Analyses

Implementation, Supply Chain, Workforce

Partners: Univ. of Puerto Rico - Rio Piedras • Mt. Holyoke College •
Springfield Technical Community College • Binghamton
University • MIT • Rice • NIST

Nanofabrication and Integration Across Multiple Length Scales

Example: High Density Data Storage



Feature size: ~ 3.1 nm
10.5 terabit/inch²

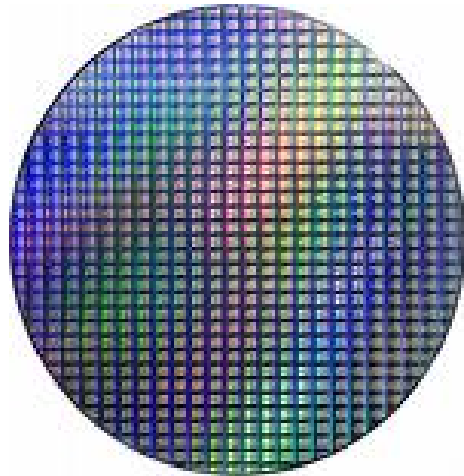
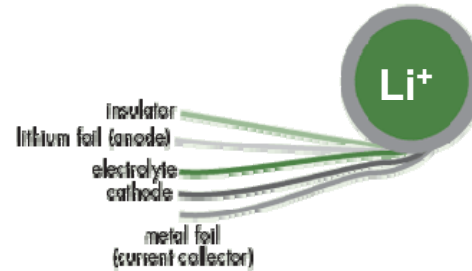
Russell Science 2009

- Approaching consensus for commercialization
- 1 Template = Master for 10⁶ devices (via NIL and daughters)

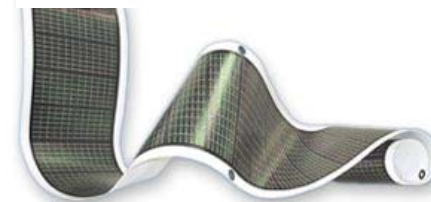
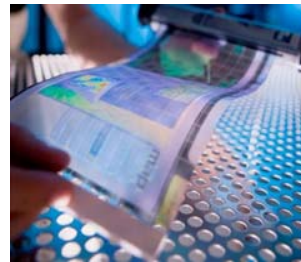
Nanotechnology Is Enabling but Many of the Most Important Applications are Cost Sensitive

Energy, Water, and Flexible Electronics

Nanomanufacturing Must Adapt to Serve Low Cost Per Area Devices

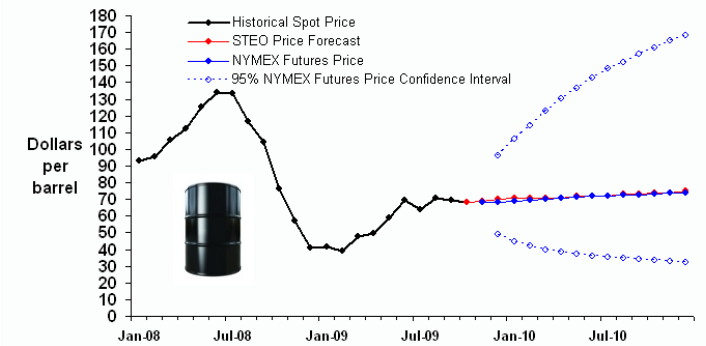


\$25,000/m²



Target ~ \$25/m²

West Texas Intermediate (WTI) Crude Oil Price



Note: Confidence interval derived from options market information on October 1, 2009

Short-Term Energy Outlook, October 2009



- Goal: A catalyst for nanomanufacturing R & D advancement in the US via:
 - Cooperative activities (workshops, conference, initiatives)
 - An information clearinghouse (internano.org)

To support, and help launch, communities of practice in nanomanufacturing in both real and cyber space

InterNano

Resources for Nanomanufacturing

a project of  National Nanomanufacturing Network

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InterNano supports the information needs of the nanomanufacturing community by bringing together resources about the advances in applications, devices, metrology, and materials that will facilitate the commercial development and/or marketable application of nanotechnology.

[Read more...](#)

What is Nanomanufacturing?

Nanomanufacturing is the essential bridge between the discoveries of the nano sciences and real-world nanotechnology-enabled products.

[Read more...](#)

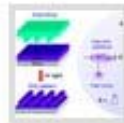


INNOVATIVE MANUFACTURING SUMMIT
Discovering and Leveraging Your Manufacturing Advantages

[View Full Calendar](#)

Industry News

- SouthWest NanoTechnologies CEO Dave Arthur to



Nanoinformatics 2010: Late-breaking Abstracts Accepted Until October 15

Late-breaking abstracts will be accepted for Nanoinformatics 2010 until October 15. Nanoinformatics 2010 is a collaborative workshop for the nanotechnology community. The event will bring together informatics experts, nanotechnology researchers and policy makers, and other stakeholders and potential contributors to jointly develop a roadmap for the area of nanoinformatics. The event will take place from November 3 - 5, 2010 in Arlington, VA.

[Read more...](#)



**Nanoinformatics
2010**

Arlington, VA
November 3-5

[Directory](#)

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Communication with Policy Makers

CHM People in the News

Mark Tuominen testifies on Capitol Hill



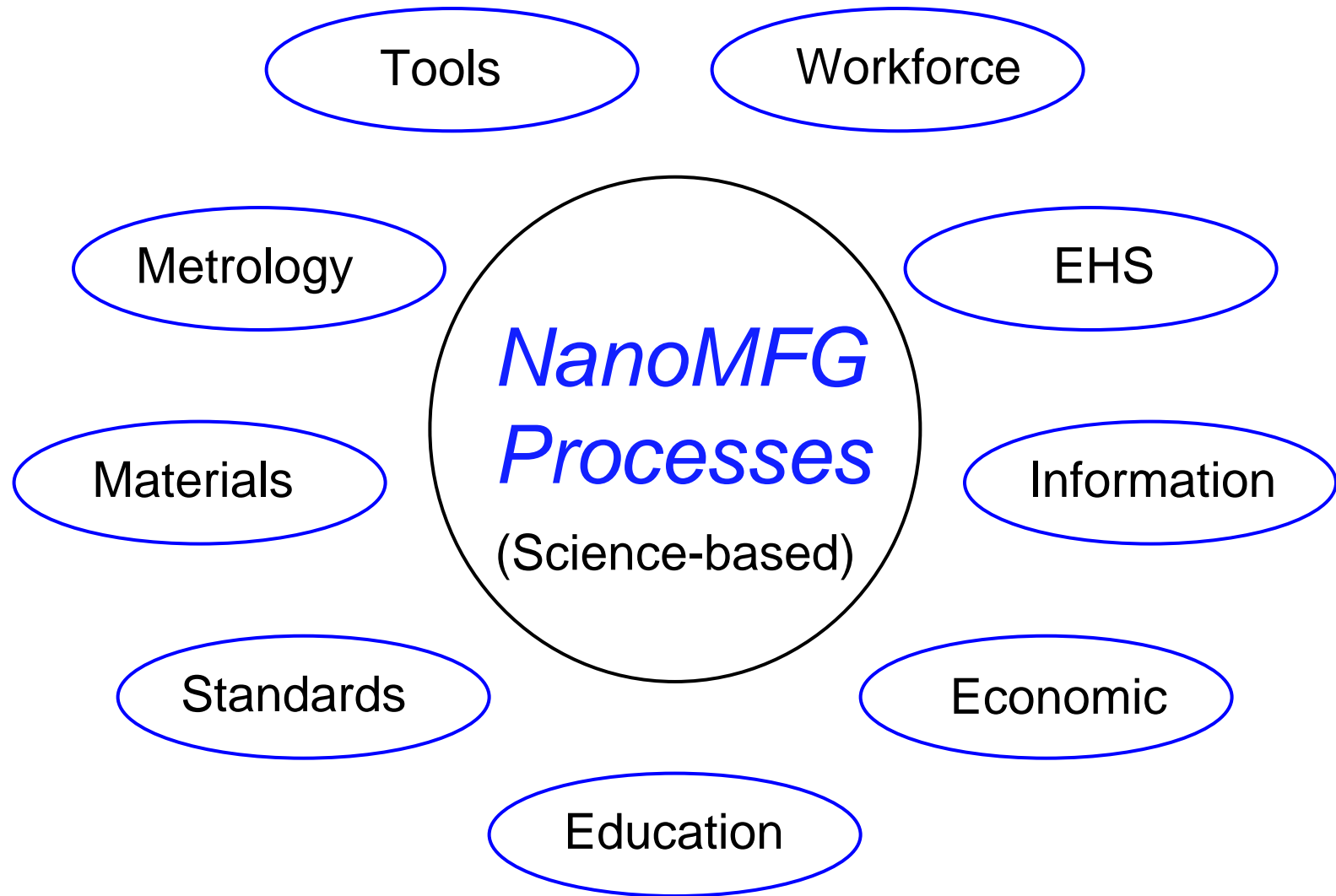
Leading nanotechnology researcher Mark Tuominen this week provided expert advice to Congress on where and how federal spending can better bolster nanomanufacturing.

Tuominen, a professor of physics and co-director of the MassNanoTech Institute, said the purpose of his March 17 testimony was to boost research and development and to foster university-industry partnerships.

[Testimony of Dr. Mark T. Tuominen](#)

Source: [UMass - In the Loop](#)

Nanomanufacturing Enterprise



To create nanomanufacturing excellence, we must attend to all parts of the value chain.

Nanomanufacturing Needs and Opportunities

- Design for manufacturing - science-based, efficient
- Throughput/scale-up development
- Establishing required process tools and material feedstock for nanomanufacturing
- Filling in missing pieces of the value chain
- Build a robust manufacturing culture
- Continuous improvement (to throughput, reproducibility, design, performance, cost)
- Research for *completely new* manufacturing pathways, including molecular, quantum, stochastic

Opportunities for manufacturing pilots, test-beds, public-private partnerships.