

Brewer Science

Empowering innovation through integrated
materials and process solutions



Brewer Science Snapshot

- Established in 1981 in Rolla, Missouri, USA
- Core competency: Polymer materials design, manufacturing, and process integration
- Industry: Semiconductor and microelectronics
- Impact: Leading technology innovator and manufacturer that enables mass production of next-generation smartphones, tablets and other electronics on a global basis
- Headquarters: Rolla, MO, USA
- Locations: Global distribution, technical support, and business offices in North America, Europe, and Asia



Dr. Terry Brewer,
President/ CEO and Founder

Benefits of working with Brewer Science

- Technology leadership in advanced materials innovation and manufacturing
- Rapid material selection for fast product-to-market implementation
- Increased performance and reduced risk for customer qualification
- Optimized custom material and process platforms
- Worldwide applications expertise and customer support

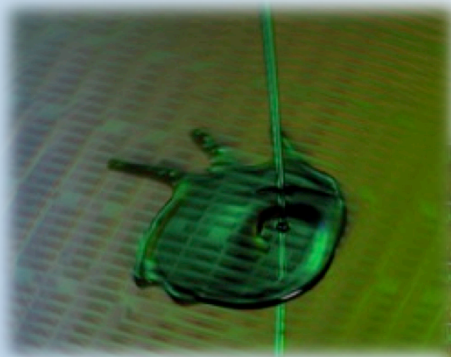


Defining the technologies of TOMORROW...TODAY, with our People for the Customer

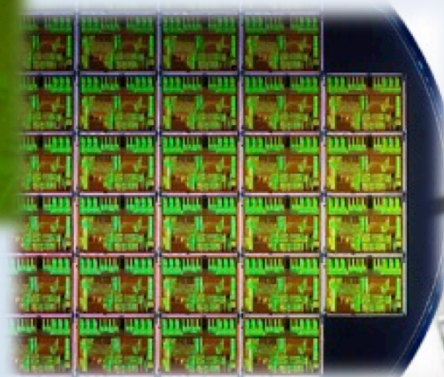


July 2013

Brewer Science plays a critical role at the beginning of creating the most advanced electronics



Brewer Science®
materials



Integrated circuits on a
silicon wafer



Central
processing
unit

Advanced
electronics

What does this mean for consumers?

We help make the products you love smaller, faster, and more powerful.



More
Functionality

Less Space

Lower Cost

Brewer Science technology areas



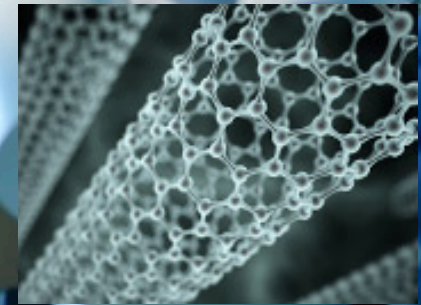
Advanced
Lithography



Advanced
Packaging



Processing
Equipment



Emerging
Technologies

Impact on the industry

- Advanced lithography- inventor of ARC[®] materials and new materials for NTD, PTD, DP, EUV and DSA
- Thin wafer handling- inventor of ZoneBOND[®] technology
- Planarizing and gap fill materials
- Protective coatings
- CNTs electronics- the first CNTs with electron grade purity
- Leader in small scale wafer processing equipment with Brewer Science Cee[®] series

Diverse patent portfolio with a commercialization rate above 50%

Hundreds of US and international patents issued

FEOL and BEOL process applications

Strong R&D focus and investment



Transforming ideas into integrated solutions



Invent



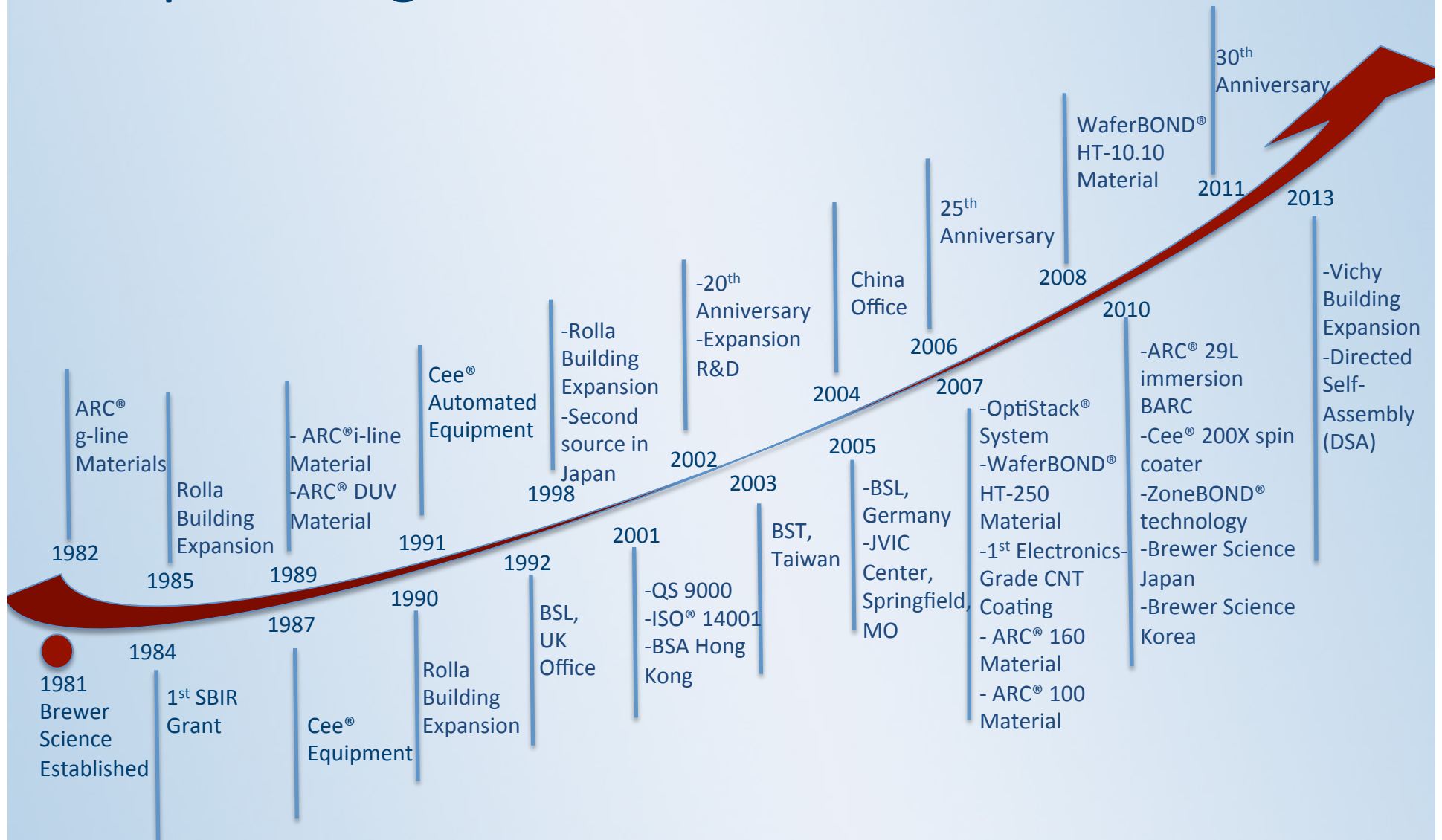
Manufacture



Integrate

Core competencies in materials design, manufacturing, and process integration

Empowering innovation for now and the future



Hundreds of products successfully implemented in 700 manufacturing facilities located in 50 countries



Global Headquarters: Rolla, Missouri, USA

Applications Labs: Rolla, Missouri, USA; Springfield, Missouri, USA; Hsinchu, Taiwan; IMEC, Belgium; Leti, France

Sales and Technical Support: Rolla, MO, USA; Albany, NY, USA; Austin, TX, USA; Derby, England; Hong Kong, China; Shanghai, China; Grenoble, France; Munich, Germany; Tokyo, Japan; Seoul, Korea; Taipei, Taiwan

Stability and determination to growth





brewer science

Where innovation takes flight!sm

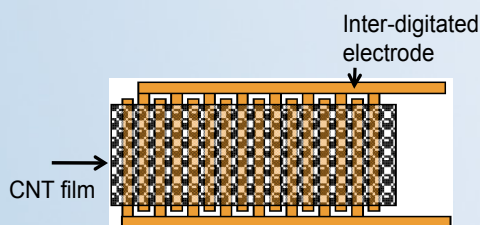
Regulatory Challenges and Impacts on Carbon Nanomaterial Development: A Microelectronics Business Perspective

Dr. Stephen E. Gibbons
Brewer Science, Inc.

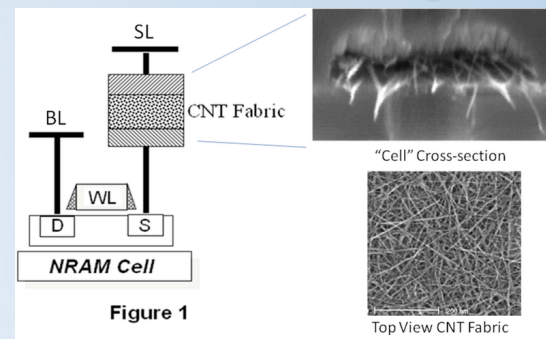


Carbon Nanomaterials Enable Life-Changing Technology

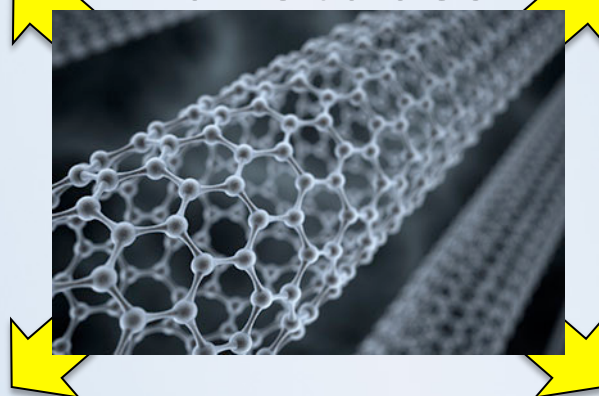
Chemical Sensor



Memory

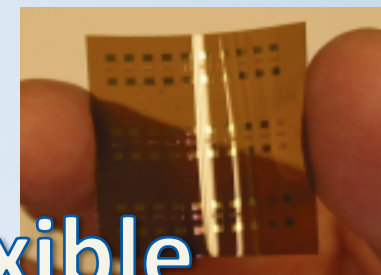


Carbon Nanotubes



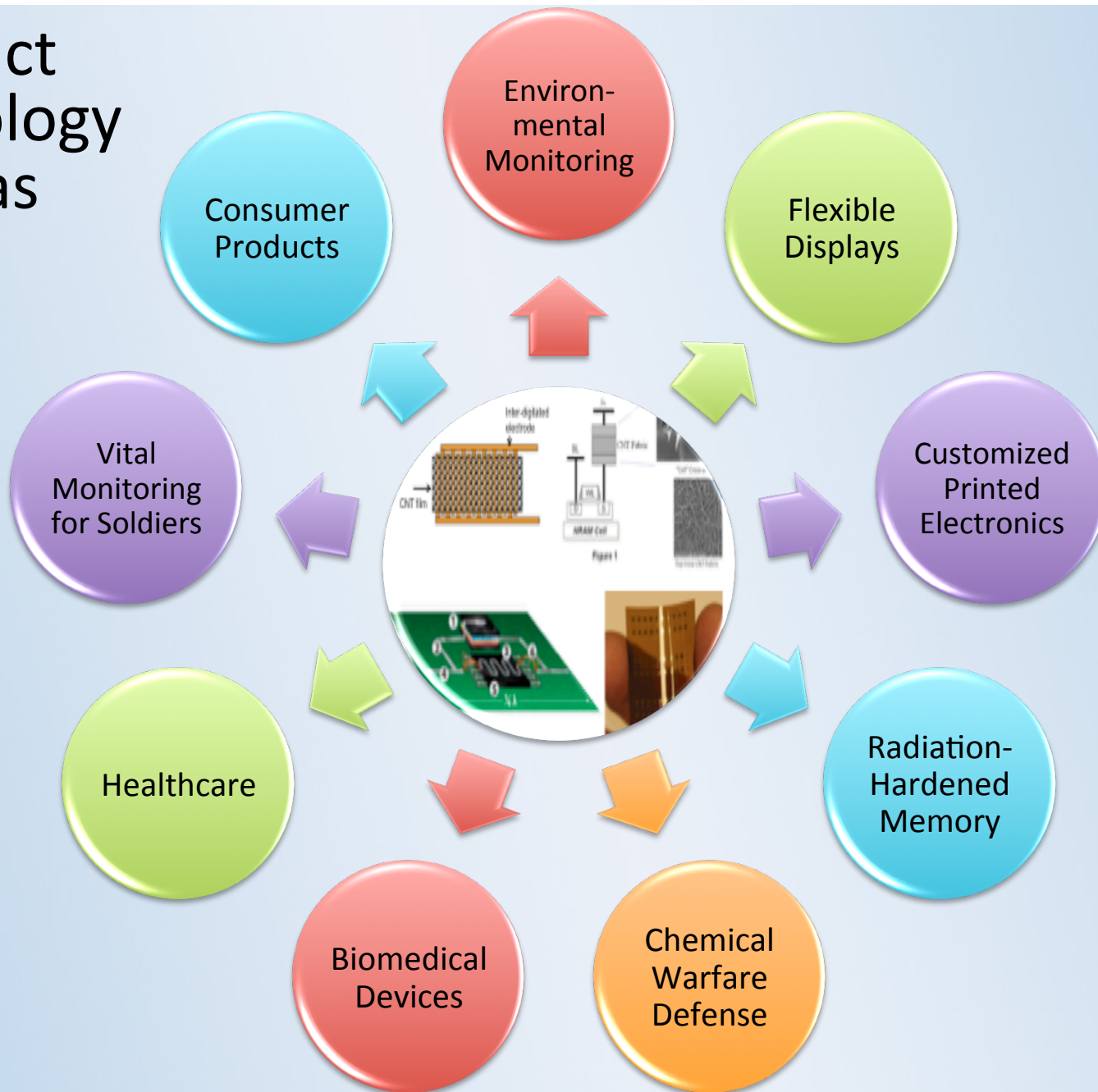
Physical Sensor

Flexible

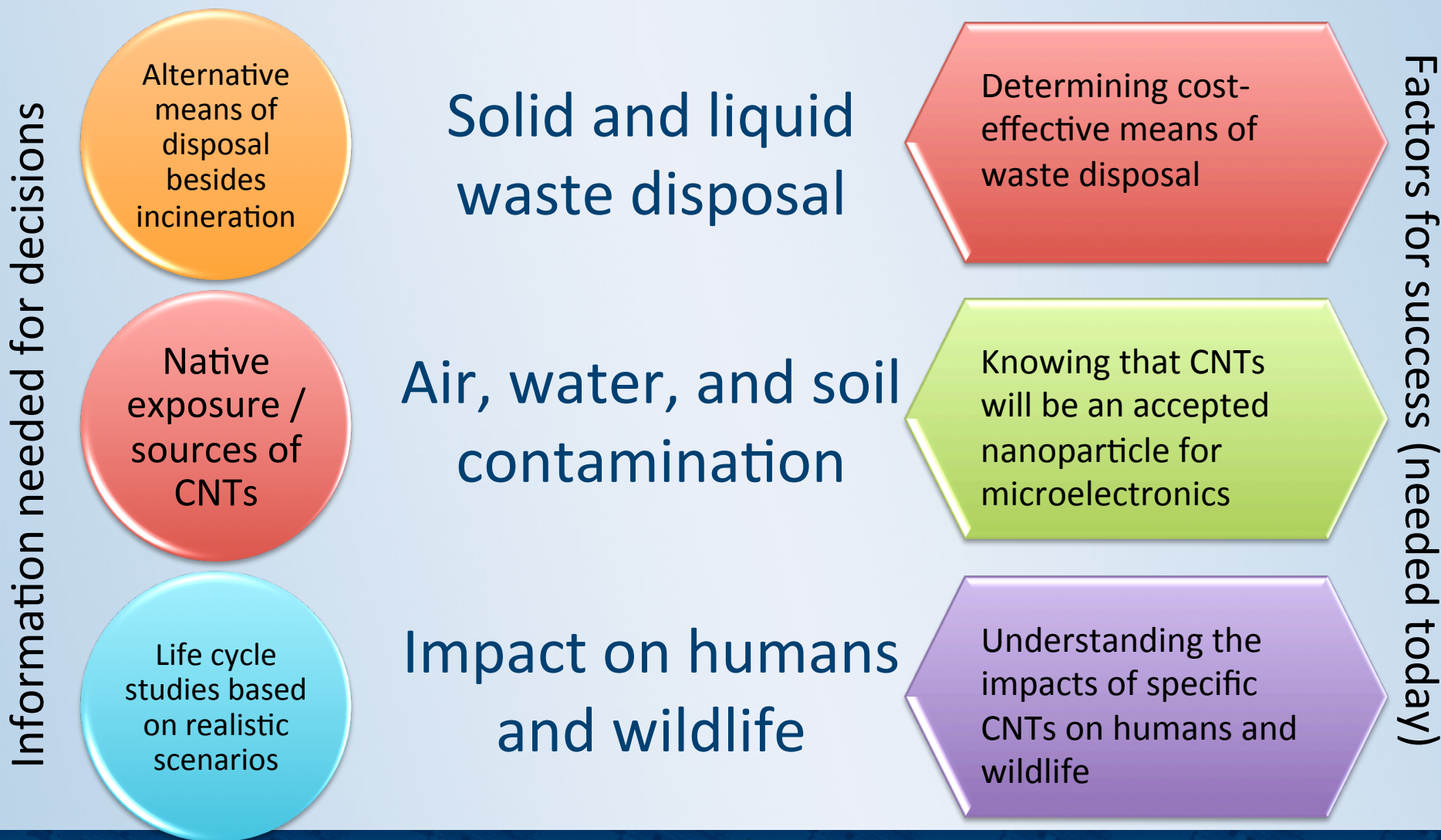


Printed Electronics

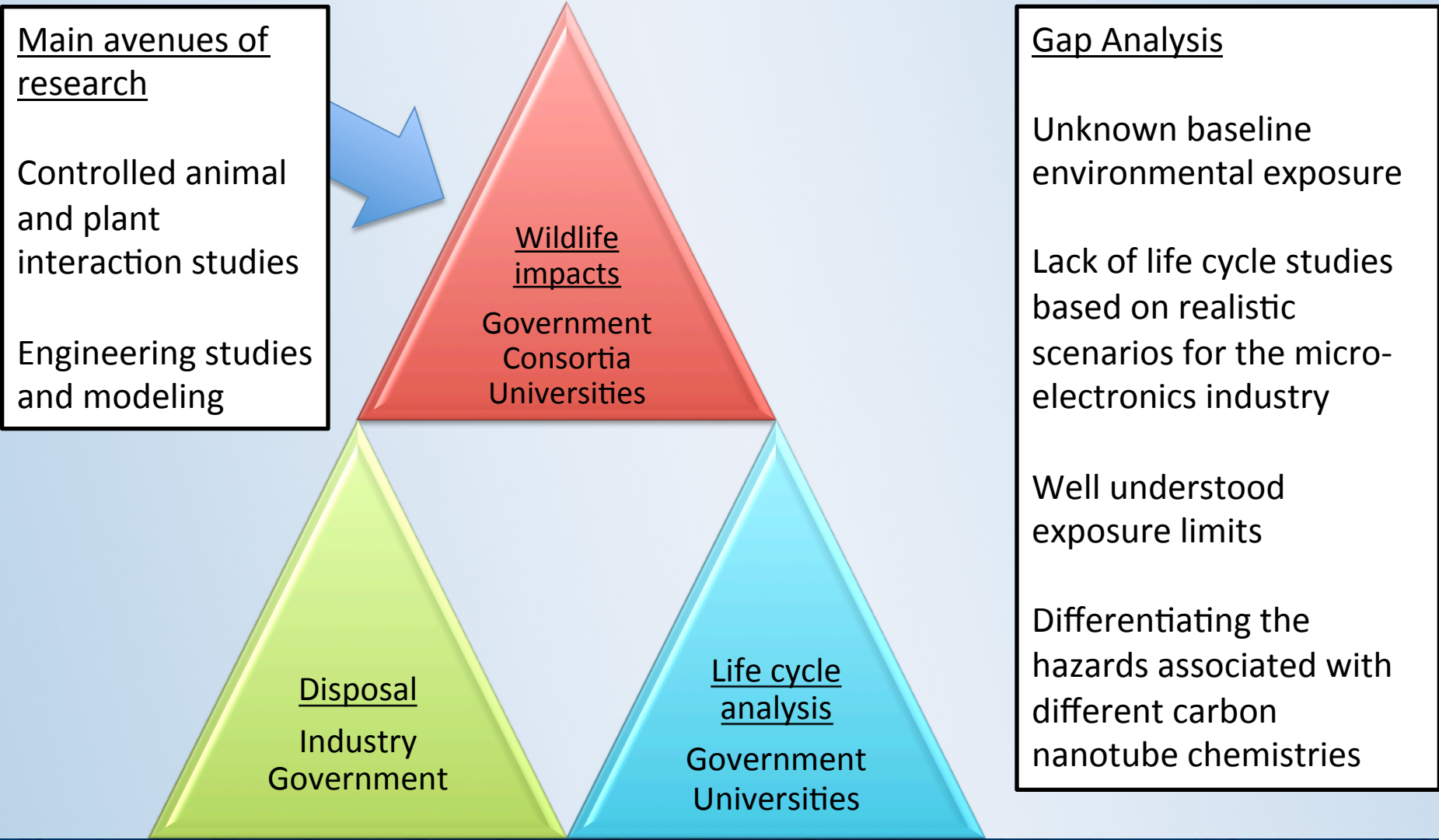
Impact Technology Areas



Carbon Nanotubes – Risk Assessment of Environmental Impacts and Aspects



Who Is Doing What, How It Is Being Done, and Gap Analysis



Risk and Uncertainty Factors vs. Decisions



Biggest factor: Identifying what hazards associated with CNTs should be investigated

How Can NNI Support?



Carbon nanotubes used in cement
1000-2000 g CNTs / metric ton cement
Vol 1 metric ton = 0.417 m³ or 14 ft³
10' x 6' x 3" slab

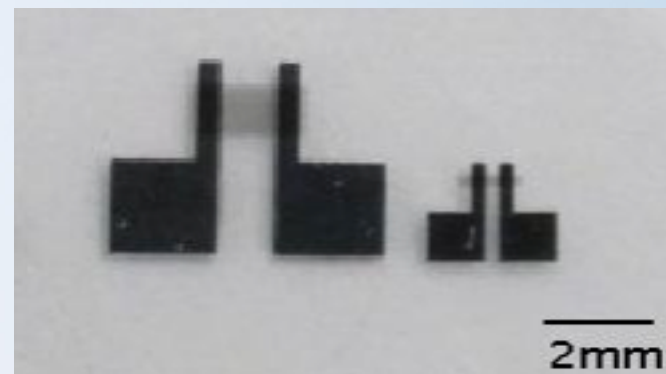
Stay as nanoparticles after deposition



CNTs are used for high-performance cementitious composites. Source: Heinz Waldukat - Fotolia.com

Carbon nanotubes used in sensors
< 100 pg / device

Exists as micro- and millisized particles after deposition



Difference between these two examples is
example is
> 1,000,000,000,000 times

How Can NNI Support?



Don't panic or jump to conclusions

- Help regulating agencies understand that different nanomaterials have different risks, even for different functionalization of the same nanomaterial

Searchable information repository

- Much work is being done – centralizing the information helps to streamline research and reduces unnecessary duplication

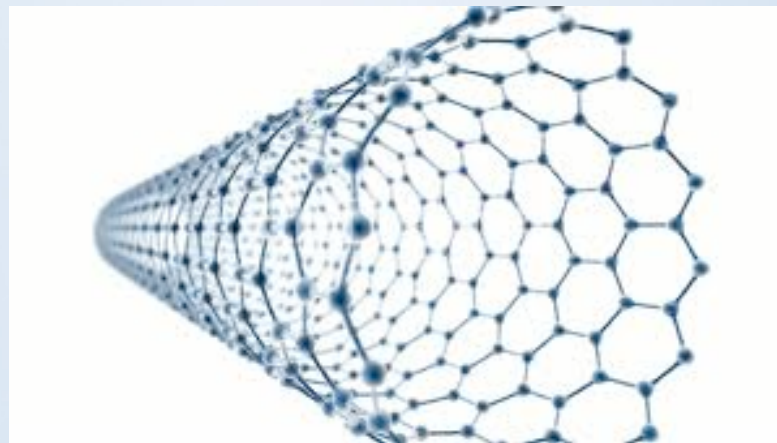


Consistency

- Develop and publish a consistent set of criteria that each nanomaterial is compared against for hazards
 - Life cycle analysis, volumes in consumer devices, etc. ...

Conclusion

Carbon nanotubes have the potential to revolutionize the microelectronics industry



Unfortunately, in the absence of hard data, many regulations are in place that are based on theoretical work and incorrect markets

Hopefully assistance from NNI can help to overcome these roadblocks to enable CNT-based technology to fulfill its potential