# Researchers help assess economic impact of nanotech on green & sustainable growth

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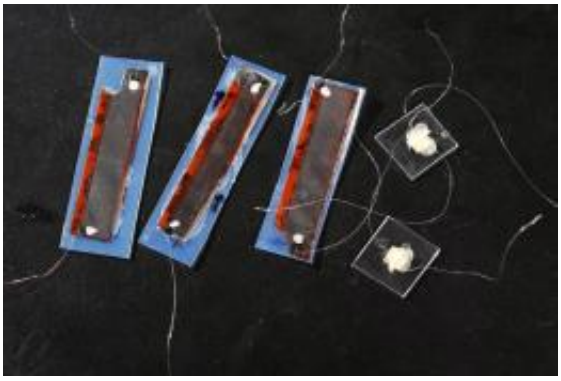

Image shows nanogenerators developed in the laboratory of Zhong Lin Wang at the Georgia Institute of Technology. Credit: Gary Meek

In the United States alone, government and private industry together invest more than $3 billion per year in nanotechnology research and development, and globally the total is much higher. What will be the long-run economic returns from these investments, not only in new jobs and product sales, but also from improvements in sustainability?

Georgia Institute of Technology researchers Philip Shapira and Jan Youtie helped answer that question through research presented March 27th at the International Symposium on Assessing the Economic Impact of Nanotechnology held in Washington, D.C. The researchers highlighted the importance of full lifecycle assessments to understand the impacts of nanotechnologies on green economic development in such

areas as energy, the environment and safe drinking water.

“Nanotechnology promises to foster green and sustainable growth in many product and process areas,” said Shapira, a professor with Georgia Tech’s School of Public Policy and the Manchester Institute of Innovation Research at the Manchester Business School in the United Kingdom. “Although nanotechnology commercialization is still in its early phases, we need now to get a better sense of what markets will grow and how new nanotechnology products will impact sustainability. This includes balancing gains in efficiency and performance against the net energy, environmental, carbon and other costs associated with the production, use and end-of-life disposal or recycling of nanotechnology products.”

But because nanotechnology underlies many different industries, assessing and forecasting its impact won’t be easy. “Compared to information technology and biotechnology, for example, nanotechnology has more of the characteristics of a general technology such as the development of electric power,” said Youtie, director of policy research services at Georgia Tech’s Enterprise Innovation Institute. “That makes it difficult to analyze the value of products and processes that are enabled by the technology. We hope that our paper will provide background information and help frame the discussion about making those assessments.”

The symposium is sponsored by the Organization for Economic Cooperation and Development and by the U.S. National Nanotechnology Initiative. Support for Georgia Tech research into the societal impacts of nanotechnology has come from the National Science Foundation through the Center for Nanotechnology in Society based at Arizona State University.

For their paper, co-authors Shapira and Youtie examined a subset of

green nanotechnologies that aim to enable sustainable energy, improve environmental quality, and provide healthy drinking water for areas of the world that now lack it. They argue that the lifecycle of nanotechnology products must be included in the assessment.

“In examining the economic impact of these green nanotechnologies, we have to consider the lifecycle, which includes such issues as environmental health and safety, as well as the amount of energy required to produce materials such as carbon nanotubes,” said Shapira.

Environmental concerns have been raised about what happens to nanomaterials when they get into water supplies, he noted. In addition, some nanostructures use toxic elements such as cadmium. Energy required for producing nano-enabled products is also an important consideration, though it may be balanced against the energy saved – and pollution reduced – through the use of such products, Shapira said.

Research into these societal issues, which is being conducted in parallel with the research and development of nanotechnology – may allow the resulting nano-enabled products to avoid the kinds of the controversies that have hindered earlier technologies.

“Scientists, policy-makers and other observers have found that some of the promise of prior rounds of technology was limited by not anticipating and considering societal concerns prior to the introduction of new products,” Youtie said. “For nanotechnology, it is vital that these issues are being considered even during the research and development stage, before products hit the market in significant quantities.”

The nanotechnology industry began with large companies that had the resources to invest in research and development. But that is now changing, Youtie said.

“A lot of small companies are involved in novel nanomaterials development,” she said. “Large companies often focus on integrating those nanomaterials into existing products or processes.”

Among the goals of the OECD symposium are development of methodologies and approaches for estimating the impacts of green nanotechnology on jobs and new product sales. Existing forecasts have come largely from proprietary models used by private-sector firms.

“While these private forecasts have high visibility, their information and methods are often proprietary,” Shapira noted. “We also need to develop open and peer-reviewed models in which approaches are transparent and everyone can see the methods and assumptions used.”

In their paper, Youtie and Shapira cite several examples of green nanotechnology, discuss the potential impacts of the technology, and review forecasts that have been made. Examples of green nanotechnology they cite include:

• Nano-enabled solar cells that use lower-cost organic materials, as opposed to current photovoltaic technologies that require rare materials such as platinum;
• Nanogenerators that use piezoelectric materials such as zinc oxide nanowires to convert human movement into energy;
• Energy storage applications in which nanotechnology materials improve existing batteries and nano-enabled fuel cells;
• Thermal energy applications, such as nano-enabled insulation;
• Fuel catalysis in which nanoparticles improve the production and refining of fuels and reduce emissions from automobiles;
• Technologies used to provide safe drinking water through improved water treatment, desalination and reuse.

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