International Symposium on
Assessing the Economic Impact of Nanotechnology

March 27 – 28, 2012

Draft Agenda

Sponsored by:

Organization for Economic Co-operation and Development (OECD) and
U.S. National Nanotechnology Initiative

Hosted by:

American Association for Advancement of Science
1200 New York Avenue NW
Washington, DC

Background/Rationale for the symposium

It is widely accepted that national investments in science and technology produce significant long-term economic benefits, yet rigorous frameworks to estimate the return on investment (ROI) have been elusive. More recently, it has been recognized that technology-based economic growth depends on a broad variety of policies and resources, sometimes referred to as an innovation initiatives. Understanding more clearly the components and dynamics of such innovation initiatives would help nations improve investment strategies and policy decisions. Improved understanding of potential ROI from the outcomes of research, particularly for emerging technologies such as nanotechnology, would help inform both public and private investment strategies.

Significant investments have also been made in supporting infrastructure for both R&D and early stage commercialization. Global annual R&D investment in nanotechnology from public and private sources has been estimated to be about US $15 billion in 2008, of which about US $3.7 billion were invested by the United States. Global venture capital investment in nanotechnology reached about $1.4 billion US dollars in 2008.[1]

Governments around the world have been steadily, and in some cases heavily, investing in nanotechnology R&D for well over a decade. R&D funding for nanotechnology – both public and private - grew about 35% per year between 2000 and 2008.[2]

The strategies under which these investments have been made generally cite potential benefits to society and the economy as driving forces behind national investment in R&D and research oriented infrastructure. More recent strategic investments have included a focus on development of manufacturing capacity, commercialization, job creation or public engagement and some consideration of the fields of industry where nanotechnologies may begin to deliver some of the envisaged potential benefits.

At the same time, with many economies struggling to emerge from the downturn initiated by the global finance crisis, governments are also looking to assess the economic returns from their significant investments in nanotechnology development. For example, in the United States, the most recent report to the President and Congress assessing the National Nanotechnology Initiative (NNI) strongly highlights the importance of measuring the value of "all products with nanotechnology components, as well as the value of those components".[3] This would help provide an estimate of the importance of nanotechnology in the economy today as well as of the ROI made or planned – for example in terms of job creation or social welfare.

Analysts and consultants have been making predications or forecasts of the potential economic impact and value of nanotechnology since the late 1990s.[4,5] Funding agencies are seeking metrics and ways to collect data on the economic impacts of nanotechnology and on the economic impacts of investments in the development of nanotechnology.

And to date there have been a number of government and academic projects which have been trying to estimate the value of nanotechnology. Several were studying the economic impact of nanotechnology for specific applications. For example, the EU's ObservatoryNano commissioned an economic analysis of nanotechnology specifically for Information and Communication Technologies (ICT) and for photovoltaics. Recently the United Kingdom Department of Environment, Food and Rural Affairs developed a much broader approach, which aimed to develop a methodology able to perform a comparative valuation of a nanotechnology-enabled material or product

[1] Roco, M.C., Mirkin, C.A. and Hersam M.C., 2011, *Nanotechnology Research Directions for Societal Needs in 2020*, Springer, National Science Foundation and the World Technology Evaluation Center report. Available on line:http://www.wtec.org/nano2/Nanotechnology_Research_Directions_to_2020/.

[2] Roco, M.C., Mirkin, C.A. and Hersam M.C., 2011, Nanotechnology Research Directions for Societal Needs in 2020, Springer, National Science Foundation and the World Technology Evaluation Center report. Available on line:http://www.wtec.org/nano2/Nanotechnology_Research_Directions_to_2020/.

[3] President's Council of Advisors on Science and Technology (PCAST), 2010, Report to the President and Congress on the Third Assessment of the National Nanotechnology Initiative.

[4] Roco M.C., R.S. Williams, and P. Alivisatos, eds. 1999. *Nanotechnology research directions: Vision for the Next Decade.* Springer (formerly Kluwer Academic Publishers) IWGN Workshop Report 1999. Washington, DC: National Science and Technology Council. Also published in 2000 by Springer. Available online: http://www.wtec.org/loyola/nano/IWGN.Research.Directions/.

[5] Roco, M.C. and W. Bainbridge, eds., 2001, Societal implications of nanoscience and nanotechnology. Boston: Springer (formerly Kluwer Academic Publishers).

against an incumbent technology. Findings and methodologies were published early this year,[6] however, there is little by way of definitive or generally accepted methodologies to identify or enumerate economic impact or value.

The objective of the symposium is to systematically explore the need for and development of a methodology to *assess the economic impact of nanotechnology* across whole economies, factoring in many sectors and types of impact, including new and replacement products and materials, markets for raw materials, intermediate and final goods and employment and other economic impacts.

Organizers: This symposium will be jointly sponsored by the Working Party on Nanotechnology (WPN) of the Organization for Economic Cooperation and Development (OECD), the U.S. National Nanotechnology Initiative (NNI), and the American Association for the Advancement of Science (AAAS).

Participants: Attendees will be invited from a broad spectrum of backgrounds and expertise, including scientists, engineers, and policy analysts from academia, industry, government, and business; private investors, technology leaders, key decision makers, and the general public.

Topics: Topics covered during the symposium will include economic metrics for other technological assessments and consideration of the appropriateness of these metrics for nanotechnology materials and products. The role of research funding portfolios, intellectual property frameworks, private sector and industry investments, patents and publications, venture capital, public-private partnerships, State and local initiatives, international cooperation, and development of a technologically-educated workforce as metrics for nanotechnology will be examined.

Venue and Timing: This symposium will be held in Washington, DC on March 27 – 28, 2012. This 2-day symposium will include topical presentations by subject matter experts, breakout panels, and networking opportunities.

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[6] DEFRA, April 2011, Methodology for estimating, in monetary terms, the benefits of nanotechnology. http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=17332

Tuesday, March 27, 2012

8:00 – 8:30 **Registration and Coffee**

8:30 – 9:00 **Welcoming Addresses**
Alan I. Leshner, CEO, American Association for the Advancement of Science, and Executive Publisher of *Science*, United States
Tom Kalil, Deputy Director for Policy, Office of Science and Technology Policy, Executive Office of the President, United States
Ken Guy, Head of the Science and Technology Policy Division, OECD

Session 1: Setting the Scene

Moderator: **Robert Wells**, Head of Unit, Science and Technology Policy Division, OECD

9:00 – 9:20 **Presentation 1**
Françoise Roure, OECD Working Party on Nanotechnology Chair, Head of the Technology and Society Section, Ministry of Economy, Finance and Industry, France

9:20 – 9:40 **Presentation 2**
Gregory Tassey, Chief Economist, National Institute of Standards and Technology, United States

9:40 – 10:00 **Challenges for Governments in Evaluating Return on Investment from Nanotechnology and its Broader Economic Impact – Overview of Background Paper 1**
Mark Morrison, Chief Executive Officer, Institute for Nanotechnology, United Kingdom

10:00 – 10:30 **Break**

10:30 – 12:30 **Government Panel Discussion**
Moderator: **Françoise Roure**, OECD Working Party on Nanotechnology Chair, Head of the Technology and Society Section, Ministry of Economy, Finance and Industry, France

- **Adalberto Fazzio**, Deputy Secretary and Coordinator of Nanoscience and Nanotechnology Secretariat for Technological Development and Innovation, Ministry of Science, Technology and Innovation, Brazil
- **Herbert von Bose**, Director Industrial Technologies, DG Research and Innovation, European Commission
- **G. V. Ramaraju**, Head of Nanotechnology Initiatives Division, Ministry of Communications and Information Technology, India
- **Kazunobu Tanaka**, Principal Fellow, National Institute of Advanced Industrial Science and Technology, Japan
- **Joseph Molapisi**, Manager for Emerging Research Areas, Department of Science & Technology, South Africa
- **Altaf Carim**, Assistant Director for Nanotechnology, Office of Science and Technology Policy, Executive Office of the President, United States

12:30 – 1:30 **Networking Lunch**

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Session 2: Exploring the Qualitative Dimensions of the Economic Impact of Nanotechnology

Moderator: **Steffi Friedrichs**, Director General, Nanotechnology Industries Association, Belgium

1:30 – 1:50 **Finance and Investor Models in Nanotechnology – Overview of Background Paper 2**
Pekka Koponen, CEO, Spinverse Ltd., Finland

1:50 – 2:10 **Economic Contributions of Nanotechnology to Green and Sustainable Growth – Overview of Background Paper 3**
Philip Shapira, Professor, Manchester Institute of Innovation Research, University of Manchester, United Kingdom, and School of Public Policy, Georgia Institute of Technology, United States

2:10 – 2:30 **Discussion**

2:30 – 2:45 **Introduction to Parallel Breakout Sessions**
Ken Guy, Head of the Science and Technology Policy Division, OECD

2:45 – 4:45 **Parallel Breakout Sessions**

- Transportation & Aerospace
  Co-chair: **Steffi Friedrichs**, Director General, Nanotechnology Industries Association, Belgium
  Co-chair: **Michael Meador**, Nanotechnology Program Manager, National Aeronautics and Space Agency, United States
  - Speaker: **Travis Earles,** Advanced Materials Nanotechnology Initiatives, Lockheed Martin, United States
  - Speaker: **Francis Peters,** Materials and Raw Materials Project Director, Michelin Worldwide, France
- Nanomedicine
  Co-chair: **Piotr Grodzinski**, Director, Nanotechnology for Cancer Programs, National Cancer Institute, United States
  Co-chair: **Alexander Pogany**, Federal Ministry for Transport, Innovation and Technology, Austria
  - Speaker: **Lawrence Tamarkin**, President and CEO, CytImmune, United States
  - Speaker: **Joerg Vienken**, Vice President Biosciences, Fresenius Medical Care, Germany
- Electronics
  Co-chair: **Luis Melo**, Professor, Physics Department of Instituto Superior, Technical University of Lisbon, Portugal
  Co-chair: **Mihail Roco**, Senior Advisor for Nanotechnology, National Science Foundation, United States
  - Speaker: **Michael Fancher**, Associate Professor of Nanoeconomics, University at Albany – SUNY, United States
  - Speaker: **Jose Rivas**, Director General, International Iberian Nanotechnology Laboratory, Portugal
- Energy
  Co-chair: **Ingo Höllein**, Deputy Director of New Materials, Nanotechnology, Federal Ministry of Education and Research, Germany
  Co-chair: **Harriet Kung**, Director, Office of Basic Energy Sciences, Department of Energy, United States
  - Speaker: **Seth Coe Sullivan**, Founder and Chief Technology Officer, QD Vision, United States
  - Speaker: **Hilary Flynn**, Senior Analyst, Lux Research, United States
- Advanced Materials
  Co-chair: **Markku Lämsä**, Senior Technology Adviser, TEKES, Finnish Funding Agency for Technology, Finland

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Co-chair: **World Nieh**, National Program Leader, Forest Products and Wood Utilization, U.S. Forest Service R&D, United States

- Speaker: **Reinhold Crotogino**, President and CEO, ArboraNano, Canada
- Speaker: **Peter Kruger**, Head of Bayer Working Group Nanotechnology, Bayer Material Science AG, Germany

- Food & Food Packaging

  Co-chair: **Knut Berdal**, Senior Advisor, Department of Food Policy, Ministry of Agriculture and Food, Norway
  Co-chair: **Hongda Chen**, National Program Leader, Bioprocessing Engineering/Nanotechnology U.S. Department of Agriculture-National Institute of Food and Agriculture, United States

  - Speaker: **Victor Berucci Neto**, Embrapa Instrumentacao Agropecuria, Brazil
  - Speaker: **Kalpana Sastry**, Principal Scientist, Agricultural Research Systems Management and Policies Division, National Academy of Agricultural Research Management, India

4:45 – 6:00 **Report Back and Synthesis Conversation**
Moderator: **Ken Guy**, Head of the Science and Technology Policy Division, OECD

6:00 **Reception**

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Wednesday, March 28, 2012

8:00 – 8:30 **Coffee**

8:30 – 9:00 **Nanotechnology Research Directions for Societal Needs in 2020**
Mihail Roco, Senior Advisor for Nanotechnology, National Science Foundation, United States

Session 3: Nanotechnology, Economics, and Regulations

Moderator: **Lynn Bergeson**, Bergeson & Campbell, P.C., United States

9:00 – 9:20 **Business-to-Business & Standards**
Ajit Jillavenkatesa, Senior Standards Specialist, Global Standards and Information Group, National Institute of Standards and Technology, United States

9:20 – 9:40 **Socioeconomic Issues**
Douglas Robinson, Managing Director, teQnode, France

9:40 – 10:00 **Regulatory Impacts & Uncertainty**
Diana Bowman, Assistant Professor, Risk Science Center and the Department of Health Management and Policy, University of Michigan, United States

10:00 – 10:30 **Discussion**

10:30 – 11:00 **Break**

Session 4: Science of Science and Innovation Policies Applied to Nanotechnology

Moderator: **Charles Wessner**, Director, Technology Innovation and Entrepreneurship, The National Academies, United States

11:00 – 11:20 **The Innovation Process and Economic Value**
Tateo Arimoto, Director-General of Research Institute of Science and Technology for Society (RISTEX), and Deputy Director-General, Center for R&D Strategy (CRDS), Japan Science and Technology Agency (JST), Japan

11:20 – 11:40 **STAR METRICS Project in the U.S.**
Julia Lane, Program Director, Science of Science and Innovation Policy, National Science Foundation, United States

11:40 – 12:00 **Brazilian LATTES System**
Esper Cavalheiro, Center for Strategic Studies and Management Science, Technology and Innovation, Brazil

12:00 – 12:30 **Discussion**

12:30 – 1:30 **Networking Lunch**

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Session 5: Approaches (New and Established) to Assess the Effects of Technology Investment

Moderator: **Stephen Campbell**, Group Leader, Impact Analysis Group of the Technology Innovation Program, National Institute of Standards and Technology, United States

1:30 – 1:50 **A Conceptual and Methodological Framework for Statistics on Nanotechnology and other Technological Areas**
Leonid Gokhberg, First Vice-Rector, National Research University "Higher School of Economics" (HSE), and Director, HSE Institute for Statistical Studies and Economics of Knowledge, Russian Federation

1:50 – 2:10 **Tools and Metrics Available to Assess the Economic Impact of Nanotechnology, and Models That Have Been Applied to Assess Economic Impact of Other Technologies – Overview of Background Paper 4**
Ben Walsh, Senior Consultant, Oakdene Hollins, United Kingdom

2:10 – 2:30 **Discussion and Introduction to Parallel Breakout Sessions**

Session 6: Exploring the Quantitative Dimension of the Economic Impact of Nanotechnology

2:30 – 4:30 **Parallel Breakout Sessions**

- Transportation & Aerospace
  Co-chair: **Minoo Dastoor**, Senior Advisor, National Aeronautics and Space Agency, United States
  Co-chair: **Steffi Friedrichs**, Director General, Nanotechnology Industries Association, Belgium
  - Speaker: **Lance Criscuolo**, President, Zyvex Technologies, United States
  - Speaker: TBA
- Nanomedicine
  Co-chair: **Piotr Grodzinski**, Director, Nanotechnology for Cancer Programs, National Cancer Institute, United States
  Co-chair: **Witold Lojkowski**, Professor from the Institute of High Pressure Physics, Polish Academy of Sciences, Poland
  - Speaker: **Richard Clinch**, Director of Economics Development, Jacob France Institute, University of Baltimore, United States
  - Speaker: **Bertrand Loubaton**, Director Pharmaceutical & Academic Collaboration, GE Healthcare & Chair of the European Technology Platform Nanomedicine (ETPN), France.
- Electronics
  Co-chair: **Luis Melo**, Professor, Physics Department of Instituto Superior, Technical University of Lisbon, Portugal
  Co-chair: **Mihail Roco**, Senior Advisor for Nanotechnology, National Science Foundation, United States
  - Speaker: **Eun-Mi Jung**, Research Fellow, Korean Institute for Industrial Economics & Trade, Korea
  - Speaker: TBA
- Energy
  Co-chair: **Jung Il Lee**, Director, Heritage S&T Centre Korea Institute of Science and Technology, Korea
  Co-chair: **Andrew Schwartz**, Program Manager, Office of Basic Energy Sciences, Department of Energy, United States
  - Speaker: **Oleg Karasev**, Deputy Director, International Foresight Centre, HSE Institute for Statistical Studies and Economics of Knowledge, Russian Federation
  - Speaker: **Xing Zhu**, Assistant President, Peking University; Deputy Director, National Center for Nanoscience and Technology; Chairman, Technical Committee for

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Nanotechnologies, Standardization Administration of China SAC TC279, Peking University, China

- Advanced Materials
  Co-chair: **Markku Lämsä**, Senior Technology Adviser, TEKES, Finnish Funding Agency for Technology, Finland
  Co-chair: **World Nieh**, National Program Leader, Forest Products and Wood Utilization, U.S. Forest Service R&D, United States
  - Speaker: **Kristen Loughery**, Economist, Office of Pollution Prevention and Toxics, Environmental Protection Agency, United States
  - Speaker: **Seth Snyder**, President, Council for Chemical Research, United States
- Food & Food Packaging
  Co-chair: **Knut Berdal**, Senior Advisor, Department of Food Policy, Ministry of Agriculture and Food, Norway
  Co-chair: **Hongda Chen**, National Program Leader, Bioprocessing Engineering/Nanotechnology U.S. Department of Agriculture-National Institute of Food and Agriculture, United States
  - Speaker**: Lynn Bergeson**, Bergeson & Campbell, P.C., United States
  - Speaker: **Rosalie Ruegg**, Director, TIA Consulting, United States

Session 7: What We Learned

Moderator: **Stephen Campbell**, Group Leader, Impact Analysis Group of the Technology Innovation Program, National Institute of Standards and Technology, United States

5:00 – 5:30 **Breakout Session Findings**
Breakout Session Co-Chairs

5:30 – 6:00 **Concluding Remarks and Next Steps**
Sally Tinkle, Acting Director and Deputy Director, National Nanotechnology Coordination Office, United States
Ken Guy, Head of the Science and Technology Policy Division, OECD

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