

Monitoring International Nanotechnology Activities

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Outline

⌘ Background on Nanotechnology

⌘ Societal and Economic Impacts

– Global Interest and Investments

⌘ OECD

– Working Party on Nanotechnology

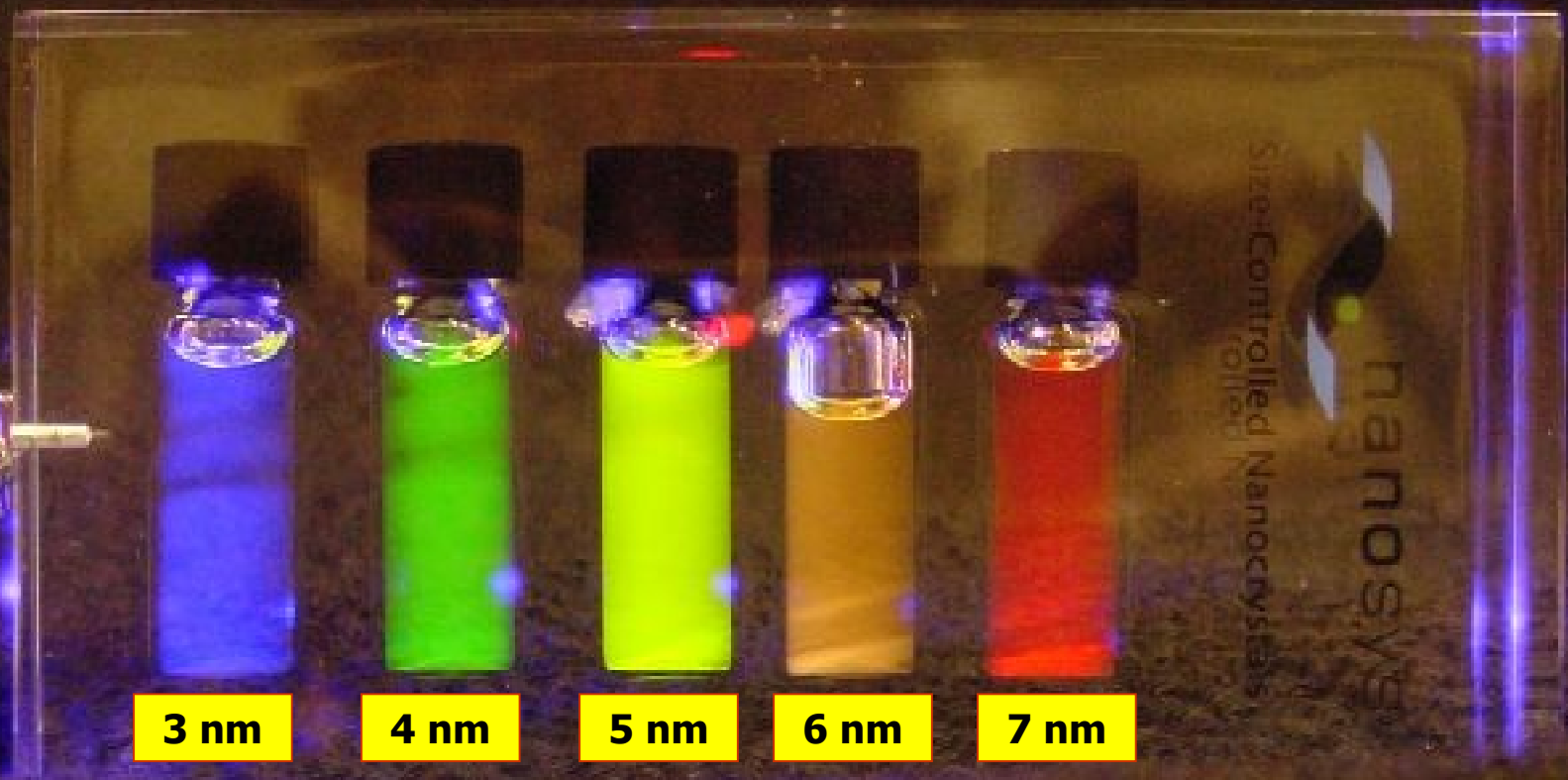
– Working Party on Manufactured Nanomaterials

⌘ Summary and conclusions

Nanotechnology: A context

Nanotechnology Development

CdSe Quantum Dots Fluorescence Color Dependent on Size of Dots



Nanotechnology is 'Now'

Selected consumer products



Nanoclay Composite

Easton CNT is Real Nanotechnology

Mountain Bike Handlebars

1.3 N (0.13 kg) weight

Carbon Nanotube Composite



resists



Tennis Racket Five Times More Rigid

Filtek™ Supreme Universal Restorative

See a difference in microfill and leaktight with our revolutionary new nanocomposite dental restorative.

It's good to be king!

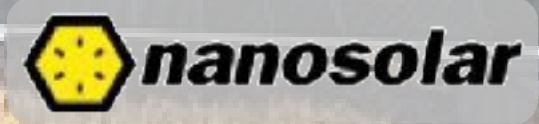
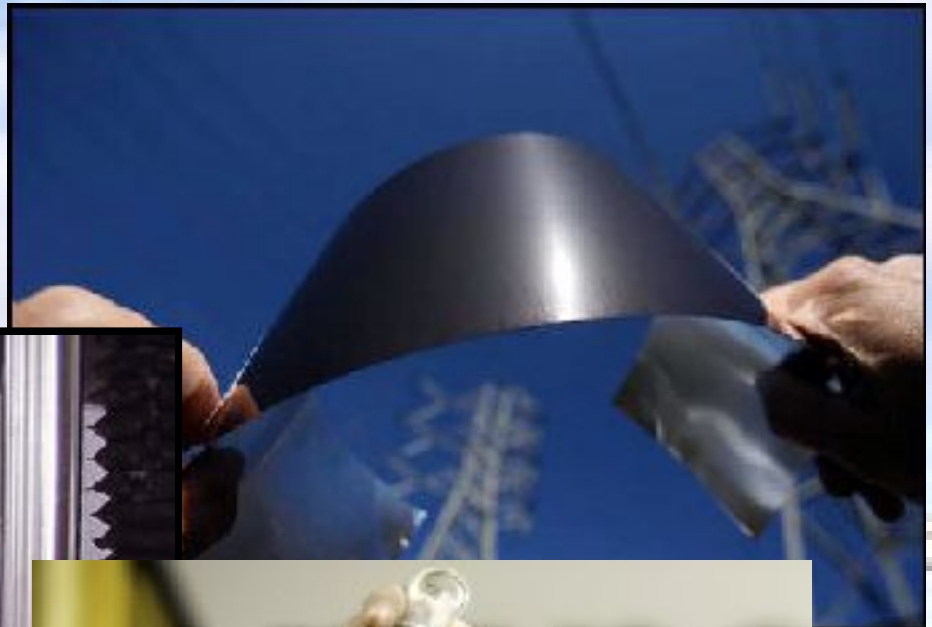


3M ESPE

Nanosilica Composite

Nanotechnology for energy production

Low-cost printed solar cells



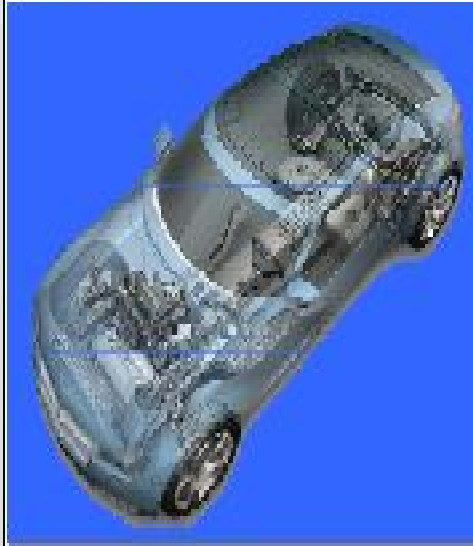
NGO uses nano-LEDs to remote communities electricity



Light Up the World Foundation

Better batteries enable energy efficiency

Plug-in Hybrids:



Lucy Sanna, EPRI

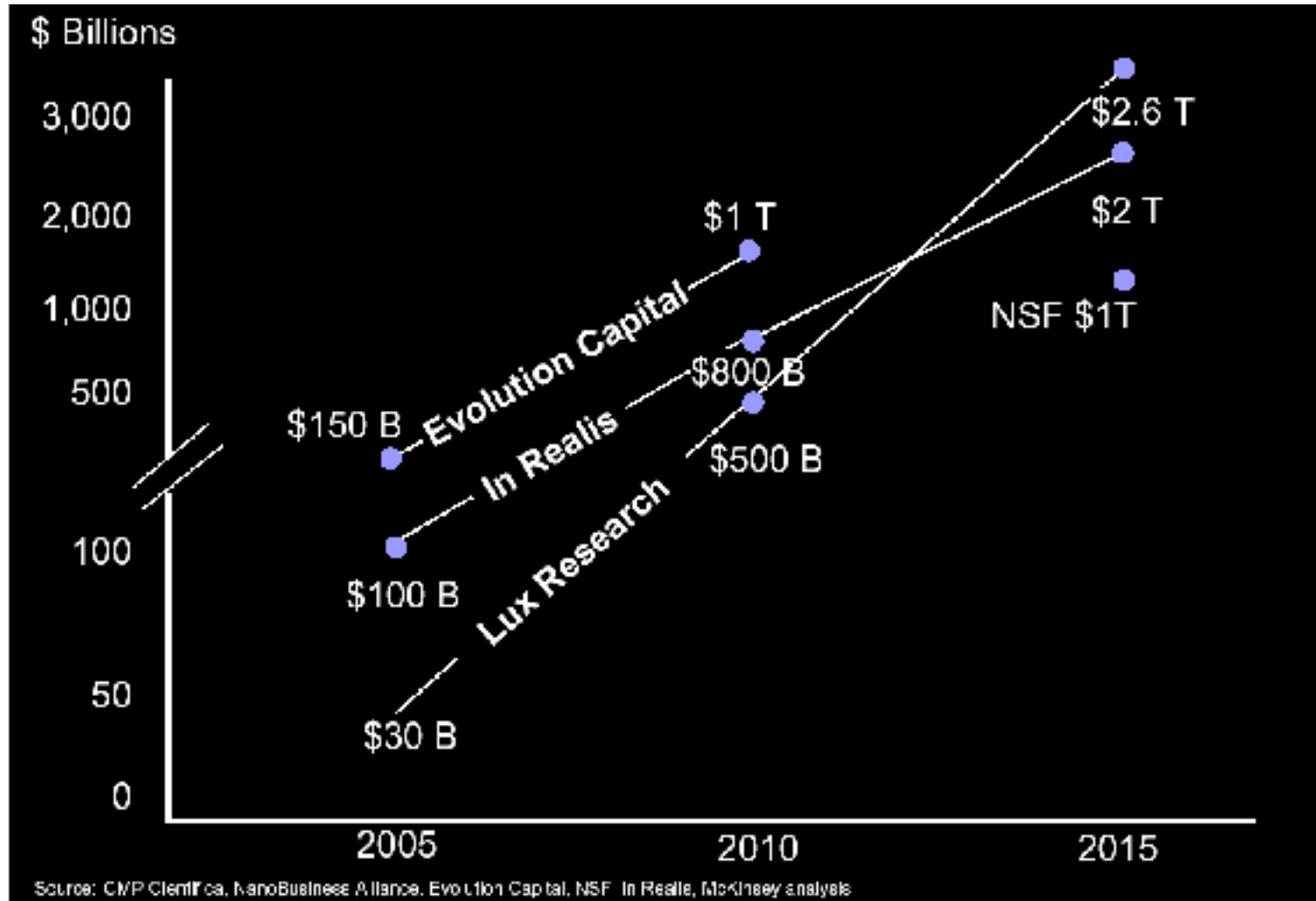
Nanotechnology in practice: Surgery using Quantum Dots



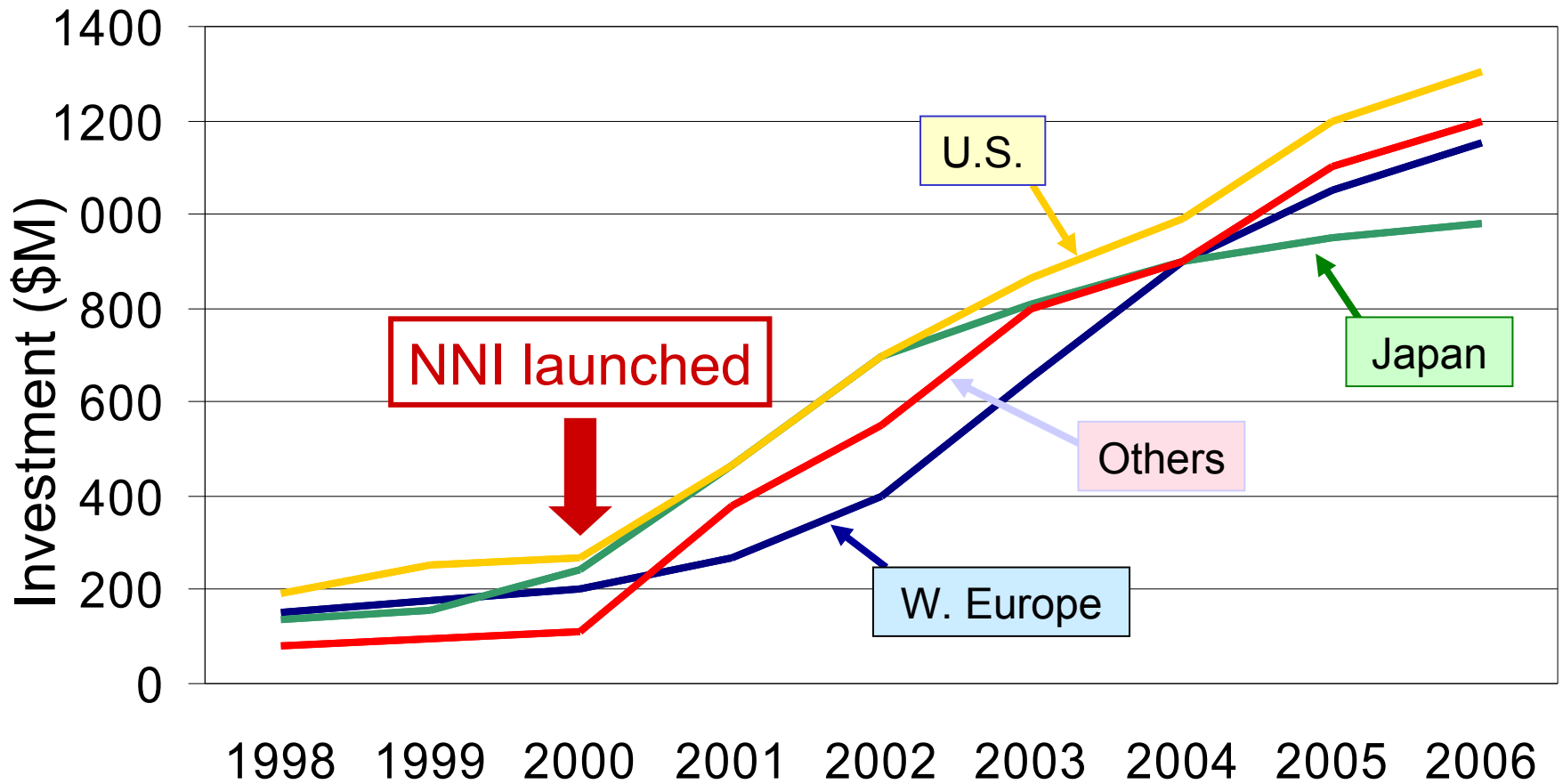
Courtesy of Dr. JV Frangioni
Harvard Beth Israel Deaconess Med Ctr.

Societal and Economic Potential

Enormous Economic Impact



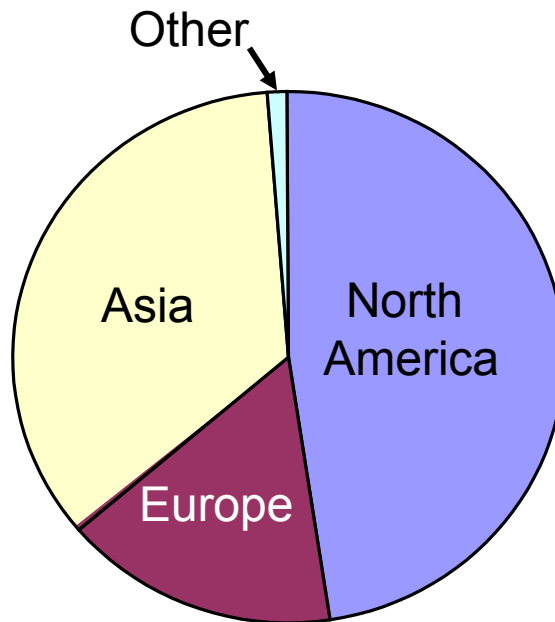
International Nanotech R&D Investment



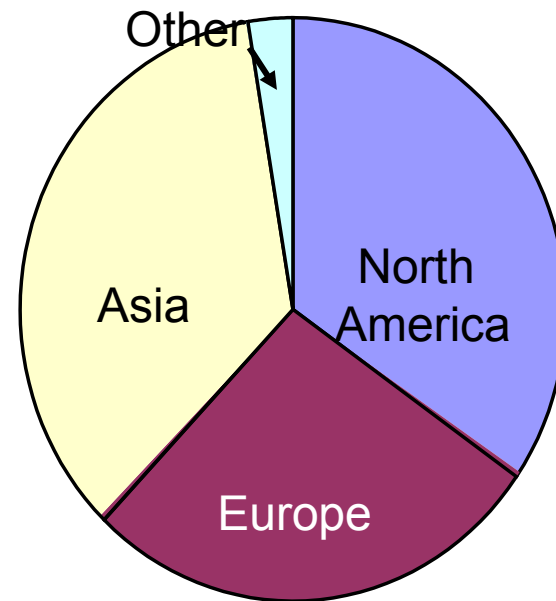
Source: C. Merzbacher/ M. C. Roco

INVESTMENT

Worldwide – \$8.6 billion in 2004



Private (Corp. + VC)
Total = \$4 billion

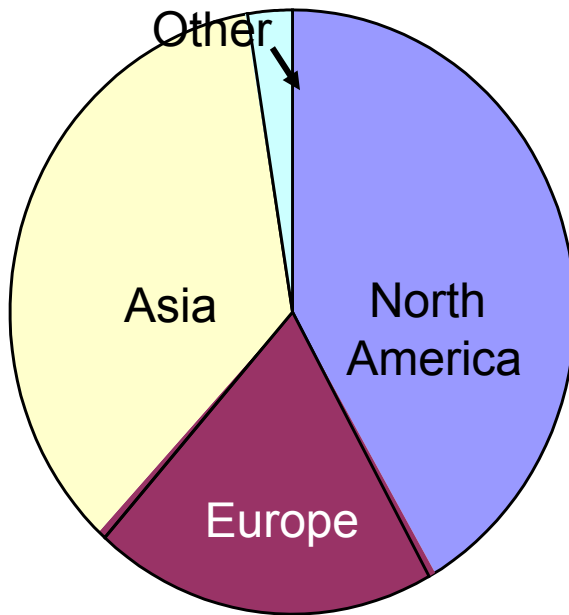


Public (National, regional, state)
Total = \$4.6 billion

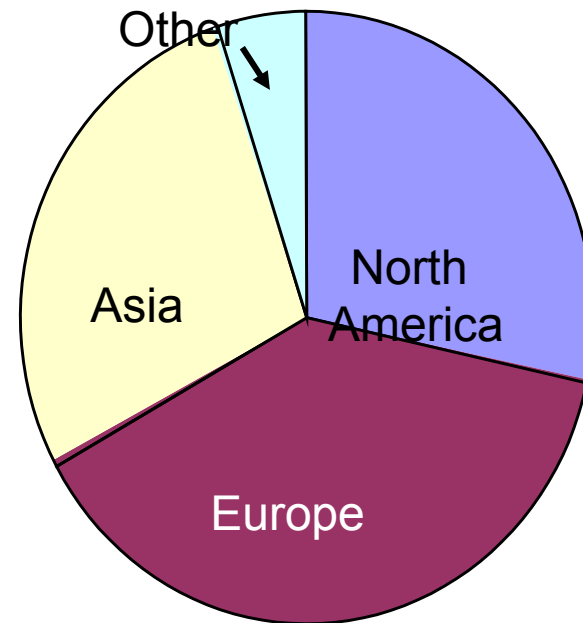
Source: Lux Research

INVESTMENT

Worldwide – \$13.8 billion in 2007



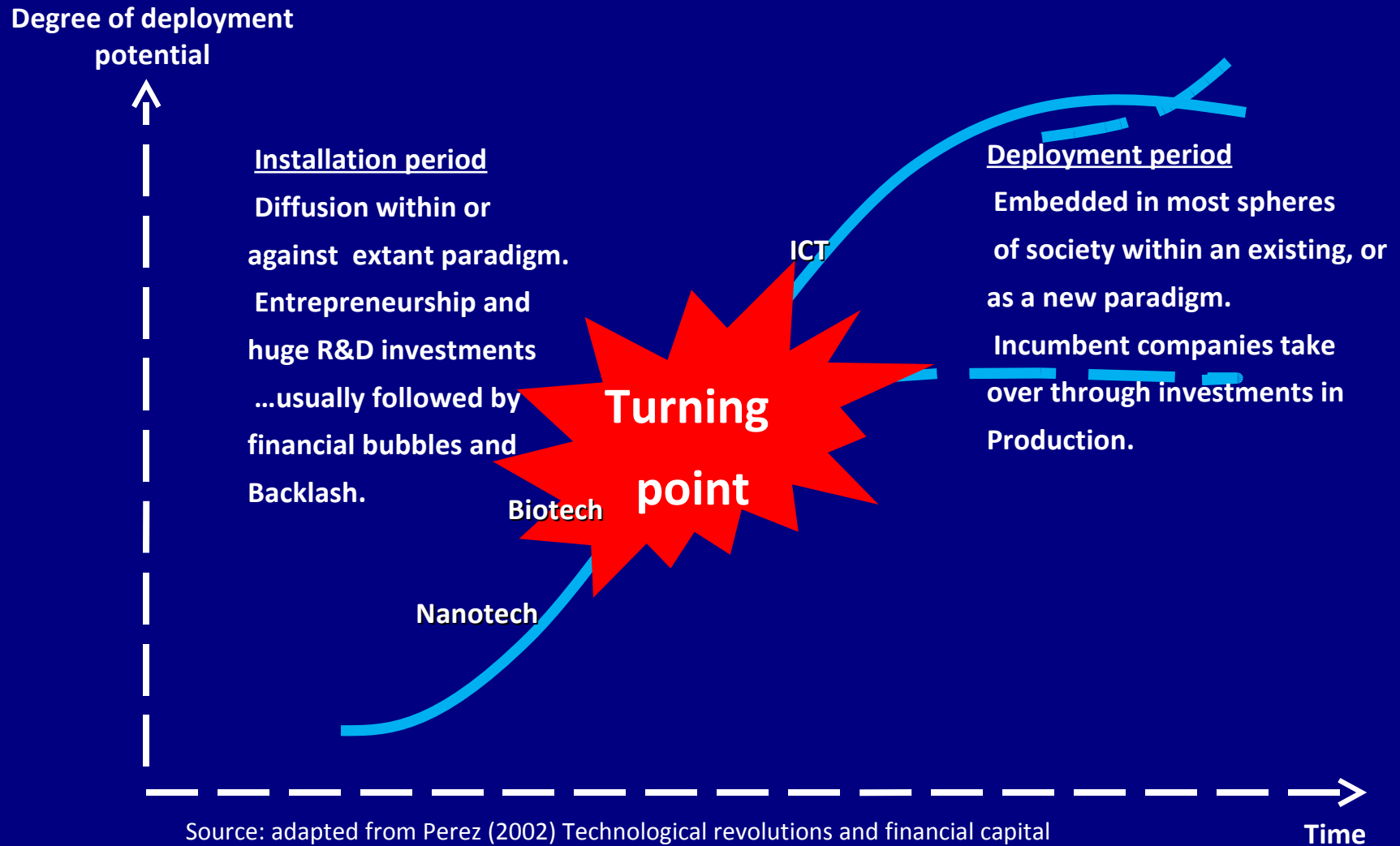
Private (Corp. + VC)
Total = \$7.3 billion



Public (National, regional, state)
Total = \$6.5 billion

Source: Lux Research

Typical life-cycle of emerging technology areas



Large interplay between countries

- ⌘ Previous technologies have seen public acceptance or rejection begin in one country and migrate to others
- ⌘ Products cross borders— safety is important
- ⌘ International regulatory regimes affect industry globally
- ⌘ Potential for trade disputes
- ⌘ Need for harmonized policies and constructive interactions between nations
- ⌘ Need for common definitions
- ⌘ Opportunities and necessity for scientific collaboration, notably with leading countries.

OECD Activities

OECD Work on Nanotechnologies

CSTP

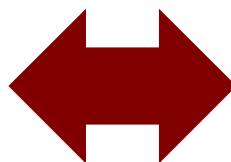
Working Party on Nanotechnology (WPN)

Focus of work

Socio-economic analysis of nanotechnology and the facilitation of international collaboration in R&D and S&T policies in the field

OECD contacts

Dirk Pilat, Christopher Palmberg, Stephanie Lacour



Chemicals Committee

Working Party on Manufactured Nanomaterials (WPMN)

Focus of work

Human health and environmental safety implications of manufactured nanomaterials (mainly the chemicals sector)

OECD contacts

Peter Kearns, Mar Gonzalez, Noriko Oki, Diana Morales

Large socio-economic promises...

Future market size somewhere in the range of 1 to 2.6 Trillion US Dollars by 2015 (private sector estimates) and an expected 2 mill. new jobs globally

Can contribute to solving issues of global concern, including: improved and accessible health care, energy, climate change, and clean water.

Eventually also (with a lag) a large impact on global economy through productivity and growth effects?

Challenges ahead

Definitional and measurement problems: lack of reliable and comparable indicators and statistics

Are new partnerships, business models and innovation environments required? What is truly new and specific to nanotechnology?

Best practices for policy

Environment, health and safety concerns

Ethical, legal and societal issues, including public perceptions

Hype and risks of backlash

Content and present activities of the WPN

Establishment and meetings of the WPN

WPN established by CSTP in March 2007

1st meeting in Leuven, Belgium, 8-9 May.-Terms of Reference, Work Plan

2nd meeting in Paris 13-16 Nov.

3rd meeting in Paris 21-24 April 2008

Work coordinated with the OECD WPMN and with other intergovernmental organizations

Involves actively 24 OECD member countries, plus some non-member participants (Russia, China, Israel, South Africa, E.U.) with active nanotechnology programs.

Also participation of ISO, BIAC and TUAC

Next meeting December 2008

Focus areas and objective of WPN



Content of WPN (I)

Project A “Indicators and Statistics”

Objectives: provide reliable, validated and comparable indicators and statistics

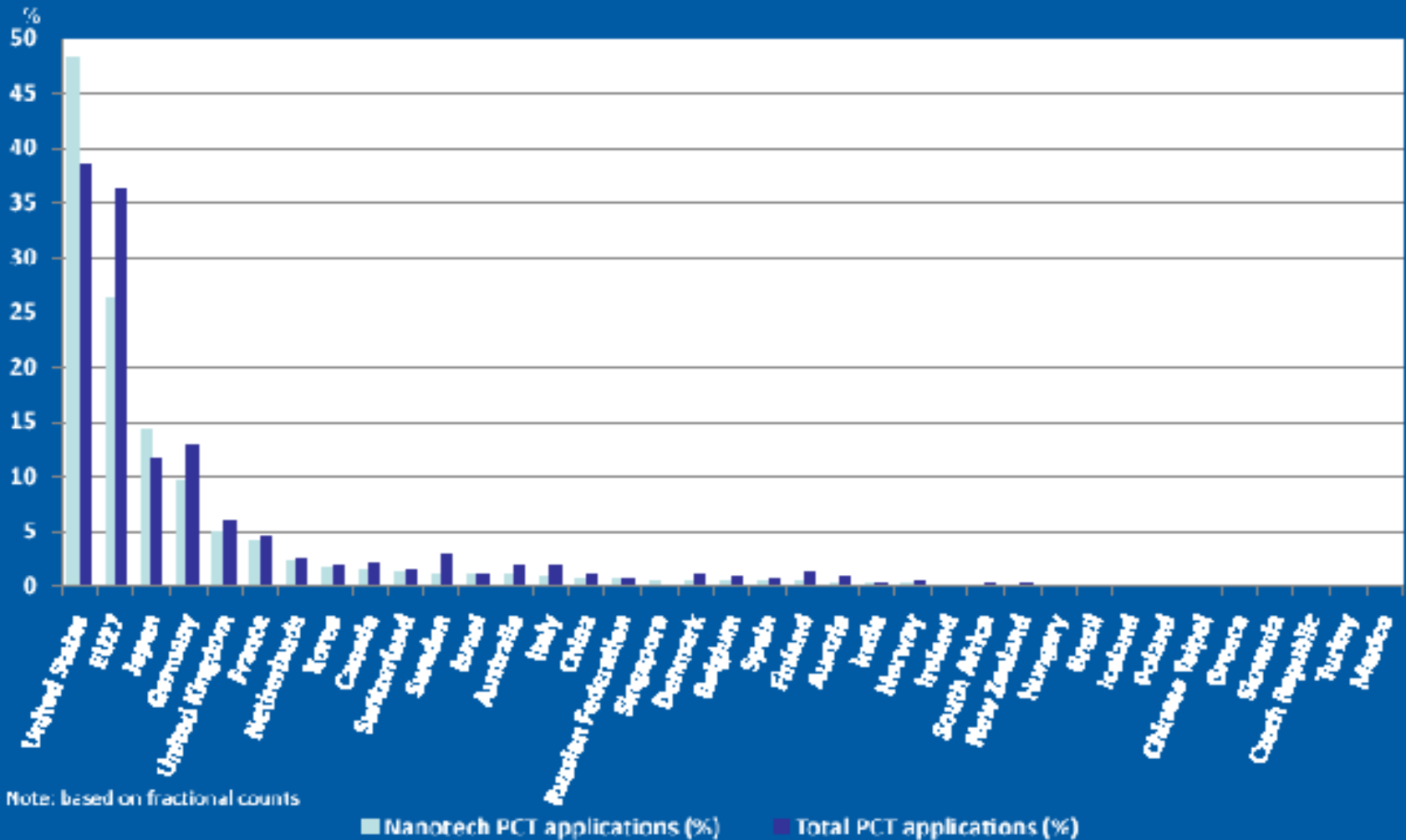
Present activities: ‘Nanotechnology at a glance’, framework for nanotechnology statistics, pilot questionnaire/surveys etc.

Expected 2008 Outputs:

“Draft framework for developing and collecting nanotechnology indicators and statistics (report/document)”, Q4 2008/Q1 2009.

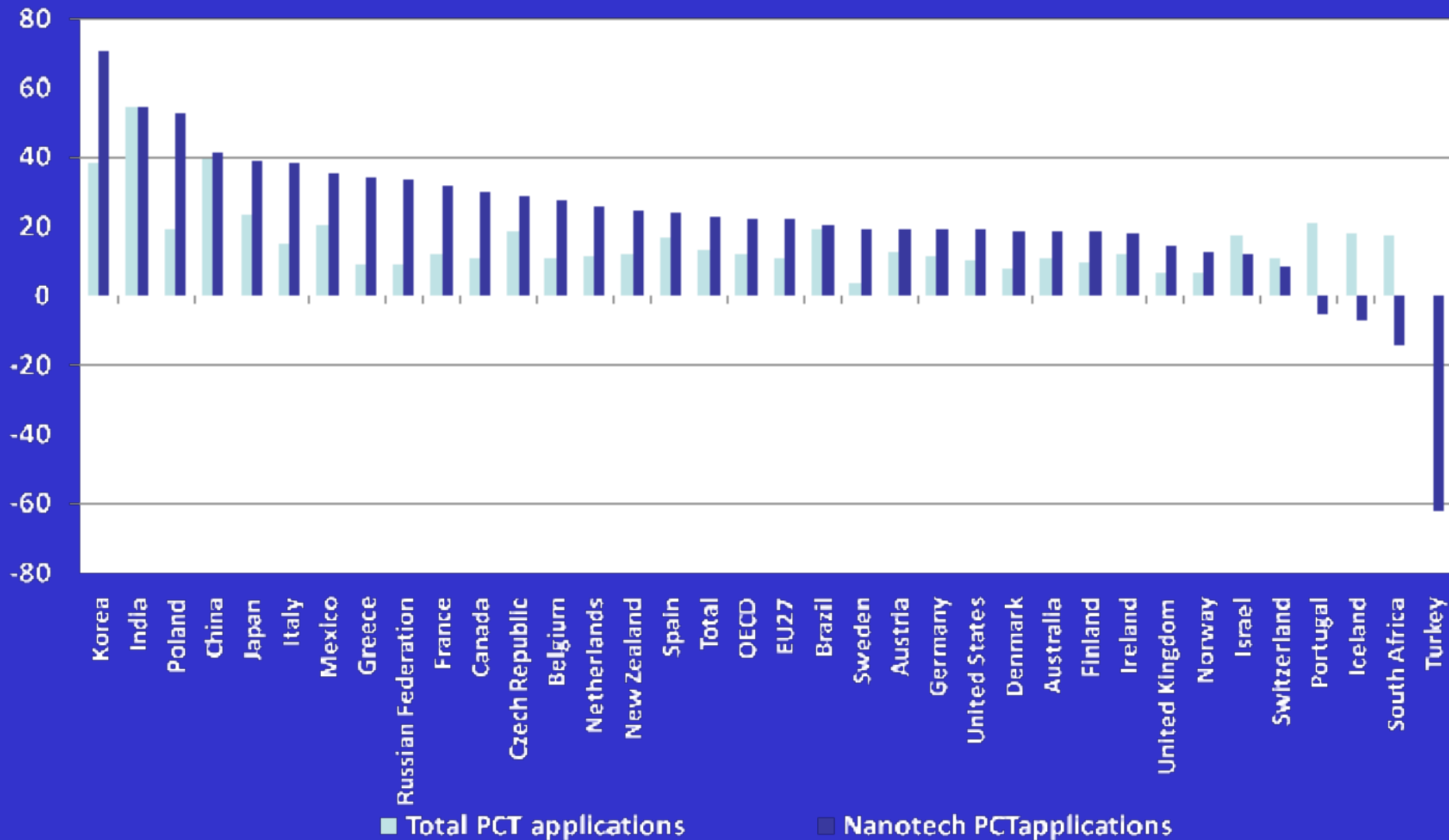
“Nanotech at a Glance” (report).

Share of country's nanotech and total patents

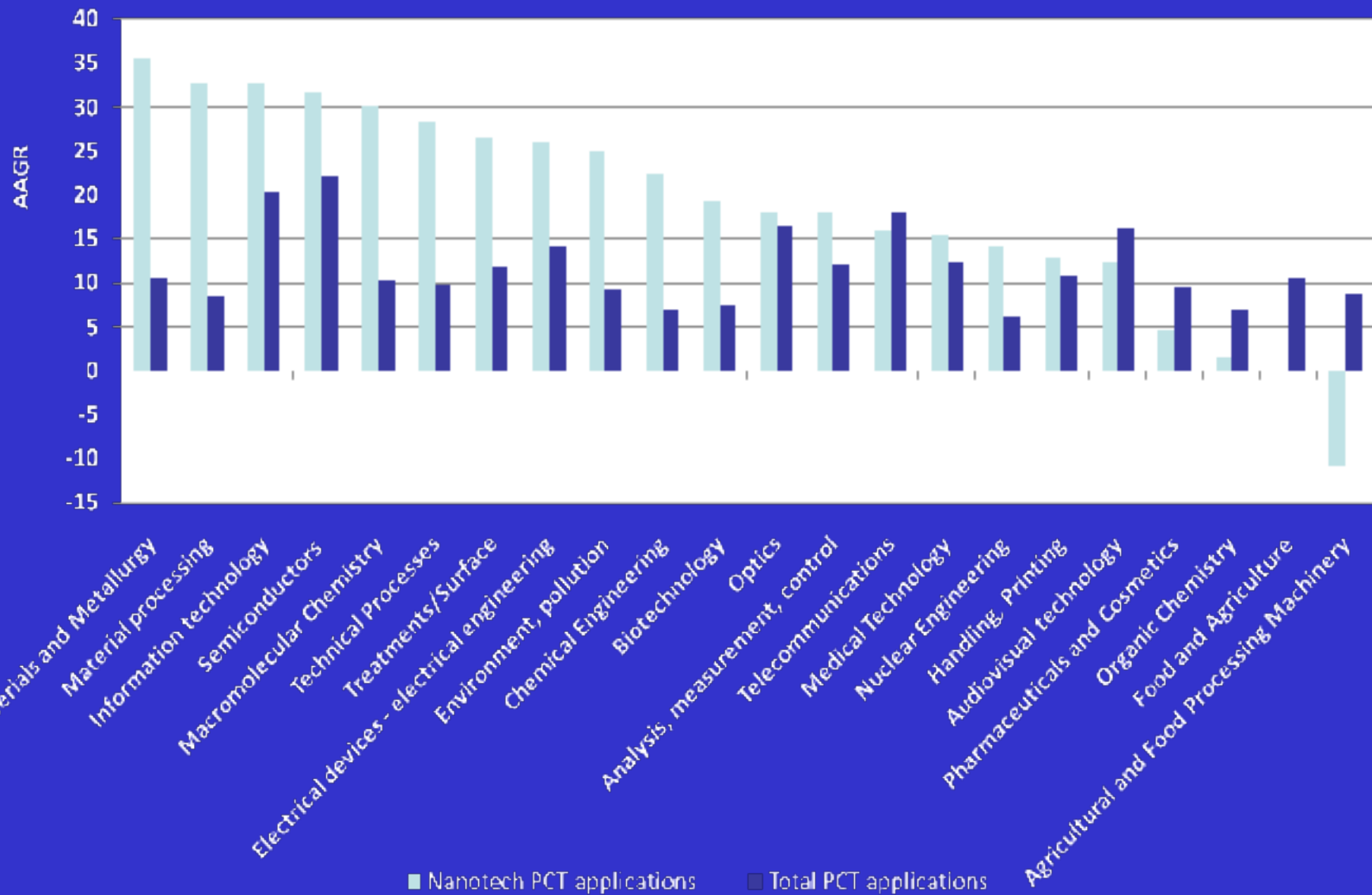


Note: based on fractional counts

Annual average growth of nanotechnology and total patents across all countries, 1995-2004



Annual average growth (AAGR) of nanotechnology and total patents by application fields 1995-2004



Content of WPN (II)

Project B “Impacts and Business Environments”

Objectives: analyze impacts on company activities (what’s special about nano?), implications for the business environment

Present activities: literature overview, company case studies, policy questionnaire and synthesis

Helsinki workshop, October 5,6

Over 40 in-depth company case studies by 14 member countries, broad coverage by size and application areas

2008 Outputs:

“Nanotechnology innovation – An overview” (working paper).

“The Nanotechnology Business: Evidence, Impacts and Policy Implications” (report), Q4 2008/Q1 2009.

Some preliminary observations

Company concerns:

Human resources

Research and development

Production

EHS and regulatory issues

Financial issues (more often among smaller companies)

An overwhelming majority have used government programs and policies to support the research and development

In addition to in-house expertise, a majority of companies draw on universities

Companies are concerned about public perception and knowledge

Content of WPN (III)

Project C “International research collaboration”

Objectives: facilitate international research collaboration

Present activities database/portal of research infrastructures

2008 Outputs:

A collection of documented links to nanotech research and infrastructure facilities and national policy programs, possibly to be developed into a searchable portal

Content of WPN (IV)

Project D “Outreach and public engagement”

Objectives: identify and promote good communication and public engagement practices

Present activities: Analyzing results of questionnaire Workshop in Delft, Netherlands October 30, 31

Outputs 2007/2008

2007 Leuven on outreach activities with 200 academic, business and policy participants

“Synthesis of questionnaire/case study findings” (working paper/document), Q4 2008.

Content of WPN (V)

Project E “Policy Dialogue”

Objectives: information gathering and synthesis on S&T policies in nano across countries, facilitation of policy dialogue

Present activities: survey and first synthesis work, planning of workshop

Expected Outputs 2008

The Development of Nanotechnology Policies in OECD countries (report), Q3 2008.

‘Economist’ workshop(s) planned for Q1 2009

Content of WPN (VI)

Project F “Global Challenges: Nano and water purification”

Objectives: analyze opportunities for the use of nano for the purification of water as a global challenge

Present activities: fact-finding

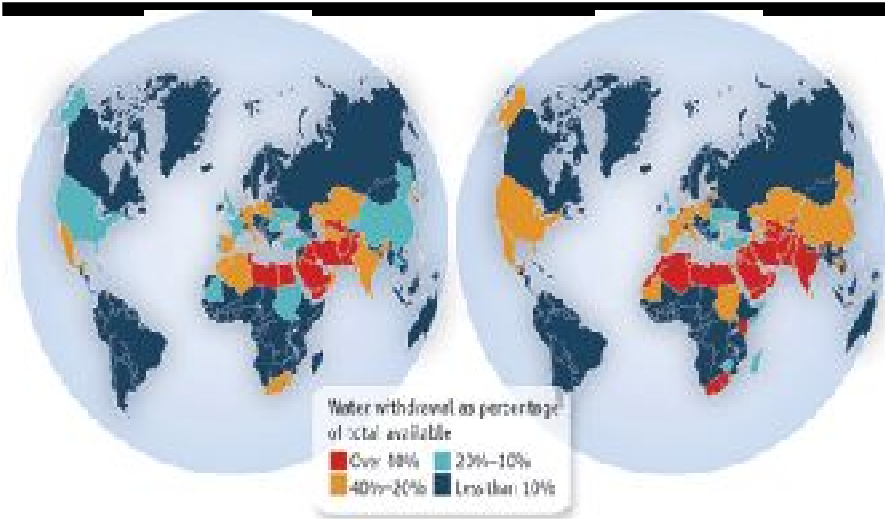
Outputs 2008

“Nanotechnology and the global challenge of access to clean water – Opportunities, barriers and policy responses” (report), Q4 2008.

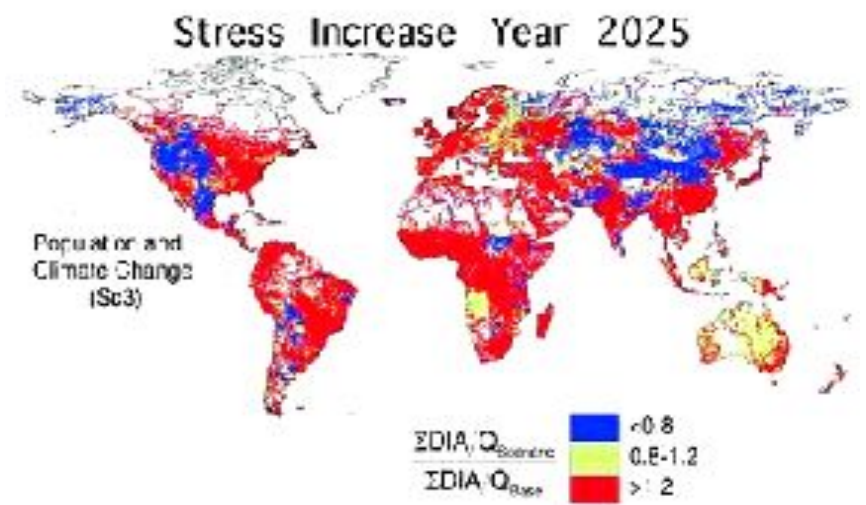
Full day session at Nanotech Northern Europe 2008 conference, “Nanotechnology and the access to clean water as a global challenge in Copenhagen 23-25/9 (<http://www.nanotech.net/>)

Major Problems Facing World

- ⌘ 1.2 Billion people at risk from lack of clean water.
- ⌘ 2.6 Billion people lack adequate sanitation
- ⌘ It is going to get worse



World Map showing water consumption world-wide as percentage of total available water.



World Map showing affect of population and climate change on water stress.

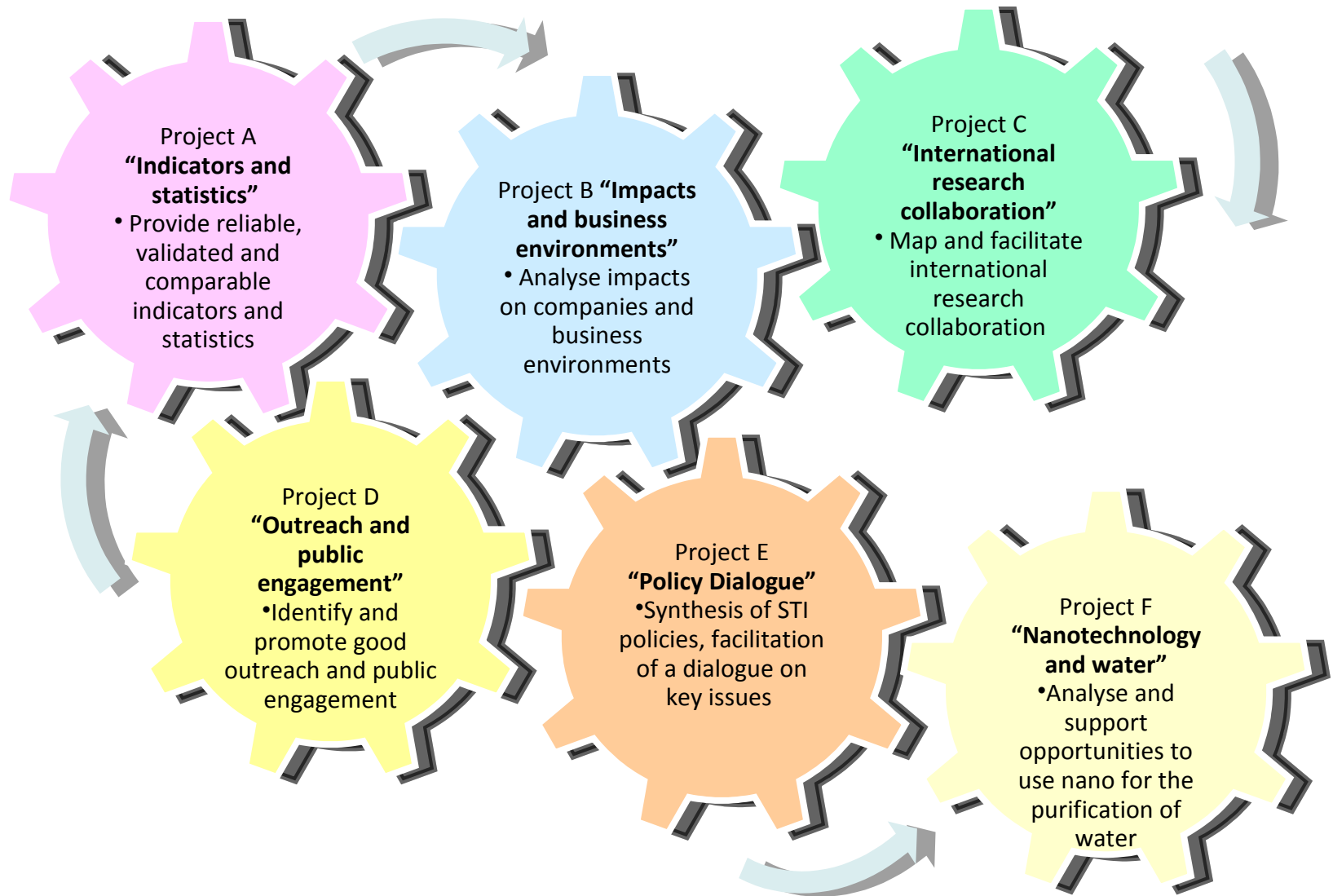
Key Nanotechnologies for Water Purification and Desalination

- ⌘ **Selective sensing & adsorption of Pb, Hg, etc.**
- ⌘ **Catalytic oxidation of micropollutants**
- ⌘ **Catalytic reduction of nitrates and other inorganic pollutants**
- ⌘ **Membrane Bioreactors for wastewater reuse**
- ⌘ **Catalytic oxidation of pathogens**
- ⌘ **UV-Vis photocatalytic inactivation**
 - Kill pathogens with ambient and plentiful light
- ⌘ **Improved membrane separation processes,**
- ⌘ **Notably improved Reverse Osmosis (inherently a nanotechnology process)**
 - High flux, non fouling
 - Nanotube membranes

Some observations

- ⌘ Nanotechnology Could Help Billions Gain Access to Clean Water
- ⌘ Likely to bring about improvements to existing methods and create entirely new approaches
- ⌘ Adoption of new methods by centralized water distribution systems will be slow
- ⌘ Nanotechnology may provide new methods in distributed distribution systems and at the point of use
 - Applicable to much of the world where centralized systems are difficult to implement

WPN project objectives and possible interrelationships



Monitoring International Nanotechnology Activities: Summary and Conclusion

Monitoring International Nanotechnology

Activities: Summary and Conclusion

- ⌘ Nanotechnology has potential in a wide broad number of applications and is projected to have an enormous economic impact
- ⌘ Competitive Development - Technologies are being developed in Europe, Asia and North America with roughly equal investments
- ⌘ For full benefits to occur, active engagement among countries is essential.
- ⌘ Cooperation with leading countries on research, standards, and policy is vital to ensuring that our publics gain the benefits of nanotechnology.
 - Developing a common language
 - Ensuring safety
- ⌘ Attention to environmental, health and safety issues is crucial for development

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