

**"NANOTECHNOLOGY: STATE OF THE ART & APPLICATIONS"**

**Sixth Annual Symposium**

**IEEE San Francisco Bay Area - Nanotechnology Council**

# **The State of Nanotechnology in Europe**

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**Santa Clara, CA**

# Topics

- European context and priorities for nanotechnology
- Organization of Nanotech research in Europe
- European-level initiatives
- National initiatives
  - Germany
  - Other countries
- Challenges in the European nanotechnology arena
- Summary
- Selected References

# Disclaimer

Due to the large number of European countries and organizations that engaged in Europe's nanotech sector, this presentation does not attempt a comprehensive overview of the Nanotechnology scene in Europe, but rather aims to showcase major trends and players who are particularly active....

# The Three Stages of Nanotechnology Advances and Adoption

- 2004 -2007
  - Initial adoption period
  - Emergence of a variety of materials and products, often accompanied by considerable hype
  - Some business successes, but also some notable failures
- 2008-2011
  - Nano-structured materials and nano-particles are incorporated into a growing range of products and processes, but usually with a lower-key approach
  - Large companies largely abandon fundamental nanotech research to academia
- 2012 onwards
  - Explosive spread of applications and deeper penetration of nanotechnologies within many application areas
  - Drivers
    - Continuing demand for energy savings, resource conservation and environmental protection
  - Greatest profit potential will lie in the manufacture of “intermediates”
    - High level of know-how is needed to fit the basic materials to particular end-use requirements
      - Functionalised nano-particles for medicine, CNT/polymer blended moulding compounds.

# Political Context for Nanotech Initiatives in Europe

- Current global financial crisis adds new urgency to the search for radical innovation to spur industrial growth and stability in the EU
- Nanotechnology is viewed as playing a major part in this process through its contributions in areas such as electronics, photonics and smart materials, as well as in health and pollution monitoring.
- Introduction of these new technologies, however, raises ethical problems that require early solution in order to win public approval for emerging products
  - Questions of governance, regulation and standardisation must be addressed in order to ensure a sustainable future for nanotechnology
  - Strong mistrust by European public towards nanotechnology and industry
- One element of the European Commission's broader research-based innovation and economic growth strategy
  - Top-down approach

# European Priorities

## Major European Nanotech Focal Areas

- **Sustainable manufacturing**

- Catalysis
  - Superparamagnetic metal oxide nano-particles
  - Photocatalytic materials
    - Construction and environmental applications
- High performance composites
  - Nano-layer coatings
  - Nano-particle fillers

- **Industrial applications**

- Nano-electronics and photonics
  - Carbon Nanotubes
- Automotive
  - Power systems/energy conversion, smart materials, safety
    - System and component levels
    - European Green Car initiative
- Construction
  - Energy Efficient Buildings JTI
    - Energy storage, collection, retention; air filtration and insulation
    - Refurbishment and restoration of existing structures
    - Nano-devices: Integration of ICT for control of the living-space environment – for example, using nanosensors embedded in prefabricated panels for ‘plug-and-play’ on-site installation

# European Priorities

## Major European Nanotech Focal Areas

- **Healthcare**

- In-vitro and in-vivo detection and diagnosis
  - Lab-on-chip devices incorporating various nano-biosensors
  - Nanoscale contrast agents improve the accuracy of in-vivo imaging
- **European Technology Platform Nanomedicine**
  - A platform for stakeholder discussions
    - Societal, regulatory and ethical issues

# European Priorities

## Major European Nanotech Focal Areas

- **Environment and Climate Change**
  - Pollution control and mitigation
    - Nano-catalysts, nano-porous filter membranes and activated nano-particles
  - Water purification and filtration
    - Photocatalytic degradation thru use of metal oxides such as TiO<sub>2</sub> and ZnO
    - Nano-particle enhanced solar disinfection
    - Molecular imprinted polymer membranes – removal of toxic chemicals and other contaminants



# European Priorities

## Major European Nanotech Focal Areas

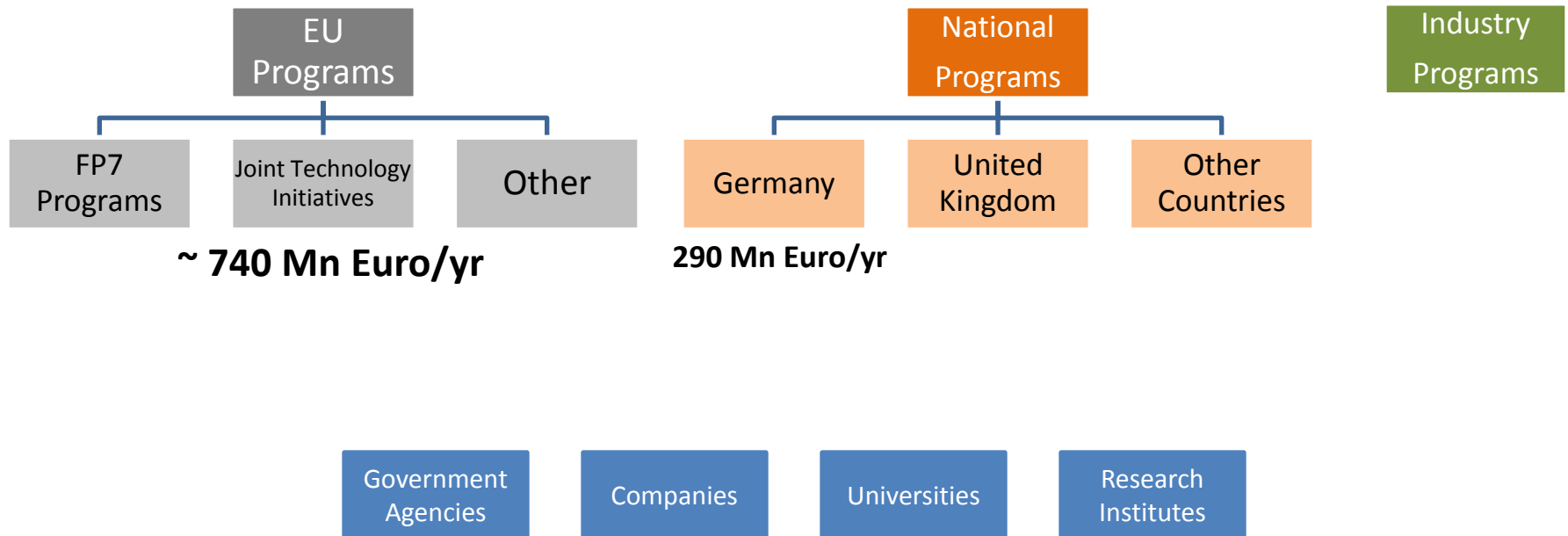
- **Alternative Energy**
  - Photovoltaic devices
  - Hydrogen fuel cells
  - Energy storage
    - Rechargeable batteries and supercapacitors
    - CNTs

# European Priorities

## Major European Nanotech Focal Areas

- **Accelerate commercialization of Nanotechnologies from research programs**
  - Establishment of a new European Technology Platform – “NANOofutures”
    - Goal:
      - Shorten the path from research to technological innovation
      - Bring nano-based products and services more rapidly to market
  - “NANOofutures would act as a framework, within which all stakeholders can join forces in carrying forward the industrialisation of N&N to benefit the European economy and all of its citizens”

# Organization of Nanotechnology Research Initiatives in Europe



# Nanotech Research @ pan-European level

## Nanotechnology research portal of the European Commission

http://cordis.europa.eu/nanotechnology/

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Financing and Innovation  
Publications and Events  
Education and Mobility  
Safety Aspects  
Communication and Debate  
Press Room

**Nanotechnology**  
nanotechnology Action Plan  
nanomedicine platform  
nanoelectronics platform  
EuroNanoForum conferences

### Welcome to the Nanotechnology Homepage of the European Commission

"Nanotechnology is an area which has highly promising prospects for turning fundamental research into successful innovations. Not only to boost the competitiveness of our industry but also to create new products that will make positive changes in the lives of our citizens, be it in medicine, environment, electronics or any other field."

(European Commissioner for Science & Research, Janez Potočnik)



#### Highlights

The [EuroNanoForum 2009](#)  
The EuroNanoForum 2009 international nanotechnology conference took place from 2nd to 5th June 2009 in the Prague Congress Centre, as an event of the Czech Presidency, under the auspices of the Czech Ministry for Education Youth and Sports and the support of the European Commission.  
The proceedings in electronic form and the conclusions are available

[Report on European activities in the field of ethical, legal and social aspects \(ELSA\) and governance of nanotechnology](#)  
This report presents figures on EC funding and a short description of all EC funded projects in the field, other activities related to information and outreach, ethics and governance on EU level, and examples of national activities in Europe.

#### Nanotechnology Projects and FP7 Funding

Please check the [EU Funding](#) and the [Information about Projects](#) section

**Feed - deadline 28/03/2008**

- FP7 model grant agreements published on 18 April 2007
- Rules for submission of proposals, and the related evaluation, selection and award procedures
- The call for experts for the Seventh Framework Programme has been launched

**>> Past Highlights**

This web service provides an overview of nanotechnology related activities at the European Commission. The information provided on this portal website does not replace or supersede similar information in other CORDIS or EUROPA websites. Rather, it highlights elements specifically relevant to nanotechnology in Europe such as the European strategy and the Action Plan, projects and funding opportunities in the Framework Programmes and related publications and events.

# How Serious is the EC's Commitment to Nanotechnology Today ??

http://cordis.europa.eu/nanotechnology/src/eu\_funding.htm

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**NANOTECHNOLOGY**

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EU Funding Opportunities | EC programmes | Funded projects FP4-FP6

Home | EU Funding | International Co-operation | Financing and Innovation | Publications and Events | Education and Mobility | Safety Aspects | Communication and Debate | Press Room

**EU Funding Opportunities**

For an overview of currently open calls related to nanotechnology with deadlines in 2008, please check the [List of activities in the FP7 calls for proposals of 2008 of direct relevance to Nanotechnology](#).

For an overview of the first FP7 calls related to nanotechnology, now closed, please check the [list of the "bullet points" in the first FP7 calls for proposals of direct relevance to nanotechnology](#). Further opportunities under FP7 are available on the [FP7 calls homepage](#).

Please note the [COST Open Call for Proposals](#) to stimulate new, innovative and interdisciplinary scientific networks in Europe. The next collection date of Preliminary Proposals is 30 March 2007.

Please note also the [Competitiveness and Innovation Framework Programme \(CIP\)](#), which complements the Research Framework Programme and supports 'Entrepreneurship and Innovation', 'ICT Policy' and 'Intelligent Energy-Europe'. The CIP is also running from 2007 to 2013 and has a budget of approximately 3.6 billion Euros.

**Other important links:**

- [NMP on European Research - Industrial Technologies](#) Commission website on NMP and other activities related to Industrial Technologies
- [CORDIS Partners Service](#): Finding a partner for EU-funded R&D projects
- [SME TechWeb](#): Information for SMEs for applying to FP6 research projects
- [National funded activities in nanotechnology](#): A database and information source on research programmes which relate to the NMP Priority and are funded nationally within the individual EU-15 Member States (and Switzerland).
- [Some Figures about Nanotechnology R&D in Europe and Beyond](#): Data on private and public funding of nanotech research worldwide. Commission staff working paper, December 2005

**Other important links related to FP7:**

- [FP7 homepage](#) CORDIS website on FP7
- [NMP in FP7](#) CORDIS website on the NMP Theme in FP7
- [FP7 experts database registration](#) Entry page for experts willing to become evaluator for FP7 project evaluations
- [CORDIS focus No.274, Issue on FP7](#), January 2007

**Other important links related to FP6:**

- [What is the Sixth Framework Programme?](#) A set of slides with all background information on FP6
- [Nanotechnology on European Research](#) Commission website on nanotechnology within NMP
- [NMP on CORDIS](#) CORDIS website on the priority NMP in FP6: general information, calls, information and support, documents and publications, news
- Mid term assessment of the NMP priority: [Position paper](#) of the [NMP expert advisory group](#) and [presentations](#), March 2005


For questions and advice, please check the [support page on the NMP webpages](#) or [contact us](#)

Last update: 2007-12-07

2008 ??

# EC Joint Technology Initiative: Nanoelectronics Technologies 2020 (ENIAC)

☆ <http://www.eniac.eu/>



European Nanoelectronics Initiative Advisory Council

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**NEWS FLASH**

**NOW AVAILABLE:**  
Report on the European Nanoelectronics Forum 2009 in Noordwijk available. [Click here to access.](#)

**VACANCIES**

**UPCOMING EVENTS**

**INC6**  
17-20 May 2010  
Grenoble, France



**Reports/Publications**

**Overviews from the European Nanoelectronics Forum 2009 now available:**


[ENF 2009 Summary article](#)

[2009 Jean-Pierre Noblanc Award](#)

[more on ENIAC JU...](#)



[more on AENEAS...](#)



[more on ENIAC platform...](#)

highlighting key moments of this event now available

**ENIAC 3rd CALL NOW OPEN**

[click here](#)

**Project Outline (PO) deadline is 30 April 2010 at 17h00 (Brussels time)**  
**Full Project Proposal (FPP) deadline is 30 July 2010 at 17h00 (Brussels time)**

Extra information available by clicking on the links below:  
[Minor changes and clarifications to information package \(30 March 2010\)](#)  
[Project Information Call 2009](#)  
[Project Information Call 2008](#)

# Germany

- **Diversified research and industry sector**
  - > 1200 organizations active in nanotechnology
    - Big companies, SMEs, institutional and academic research facilities, networks and competence centers as well as providers of financial and consulting services
  - ~ 750 companies engaged in nanotechnology at all stages of the value and supply chain
    - ~ 80 % are SMEs; ~ 370 firms are nanotechnology “core firms” with > 30 % of business activities
    - About 1/2 of the nanotech firms in Europe are German firms
    - Manufacturers:
      - Nano-materials, nano-tools, nano-analytics and equipment for the operation of nano-tools
      - Nano-optimized components and systems
    - Service providers:
      - Consulting, contract coating, technology transfer, contract analysis and research
- **Sales/Revenues (2007)**
  - ~ 33 Bn Euro; > 50% of firms expect increases in sales of > 10 % compared to 2007
- **Markets**
  - Highly export-oriented
  - For ~ 50% of companies, the German domestic market accounts for < 25% of sales
  - Only 1/5th of companies regard Germany as dominant business market (> 75 % of sales)
  - Most important market behind Germany is Europe, followed by North America and Asia
- **Employment (2009) ~ 63,000**

# Germany

- Major Companies
  - Bayer MaterialsScience
  - Degussa
  - Siemens
- Leading research institutions
  - Max Planck Institute
  - Fraunhofer Gesellschaft, Bremen
  - UniTuebingen
  - Karlsruhe Institute of Technology
  - Ruhr University Bochum
  - UniErlangen
  - TU Muenchen

*Partial listing of Organizations engaged in  
nanotechnology-related research and/or  
commercialization*



# Germany

- Major projects
  - NanoMobil (automotive sector)
    - BMBF has supported 18 collaboration projects with 99 partners in the automotive sector since 2004
    - Total subsidy amount of 36.4 Mn Euro
- Major challenges
  - Germany is considered Europe's leader in nanotechnology
    - High quality of basic research and well-developed R&D infra-structure
  - BUT Germany is relatively slow to translate nanotech research results into commercial products
    - The USA and Southeast Asia are far quicker to develop nanotechnology products, markets and sectoral strategies

# Switzerland

- Research Institutions
  - EPFL
  - ETHZ
  - CSEM, Neuchatel
  - UniBasel
- Companies
  - IBM Research

*Partial listing of Organizations engaged in nanotechnology-related research and/or commercialization*

# Italy

- Research Institutions
  - UniPerugia
  - UniVenezia
  - UniBologna
  - UniTrieste
- Industry
  - FIAT
  - Cluster Veneto

*Partial listing of Organizations engaged in nanotechnology-related research and/or commercialization*

# France

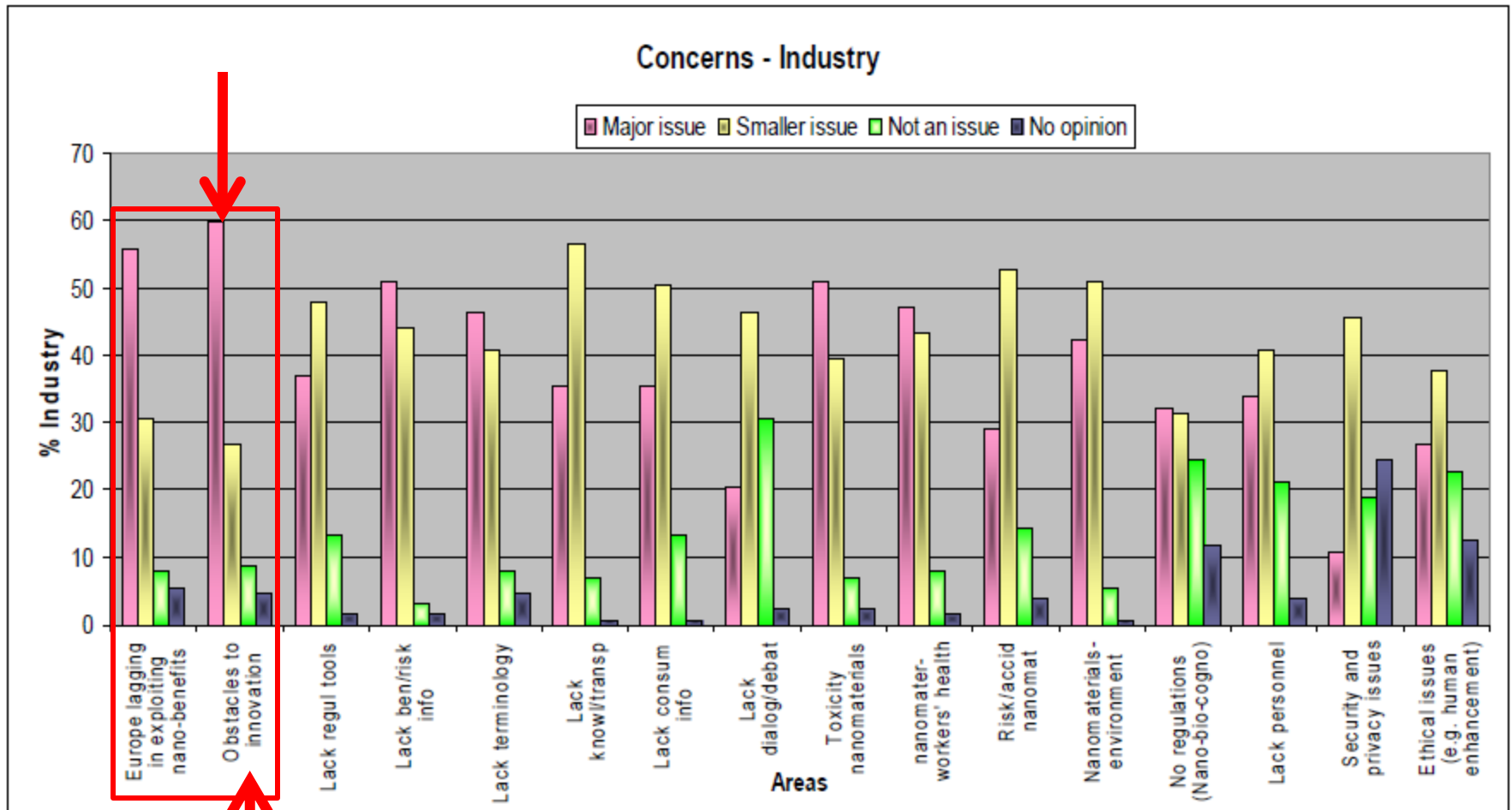
- Research Institutions
  - CEA-MiNaTec
  - CNRS
  - UniLille
  - ENSChimie

*Partial listing of Organizations engaged in nanotechnology-related research and/or commercialization*

# Challenges in the European Nanotechnology Arena

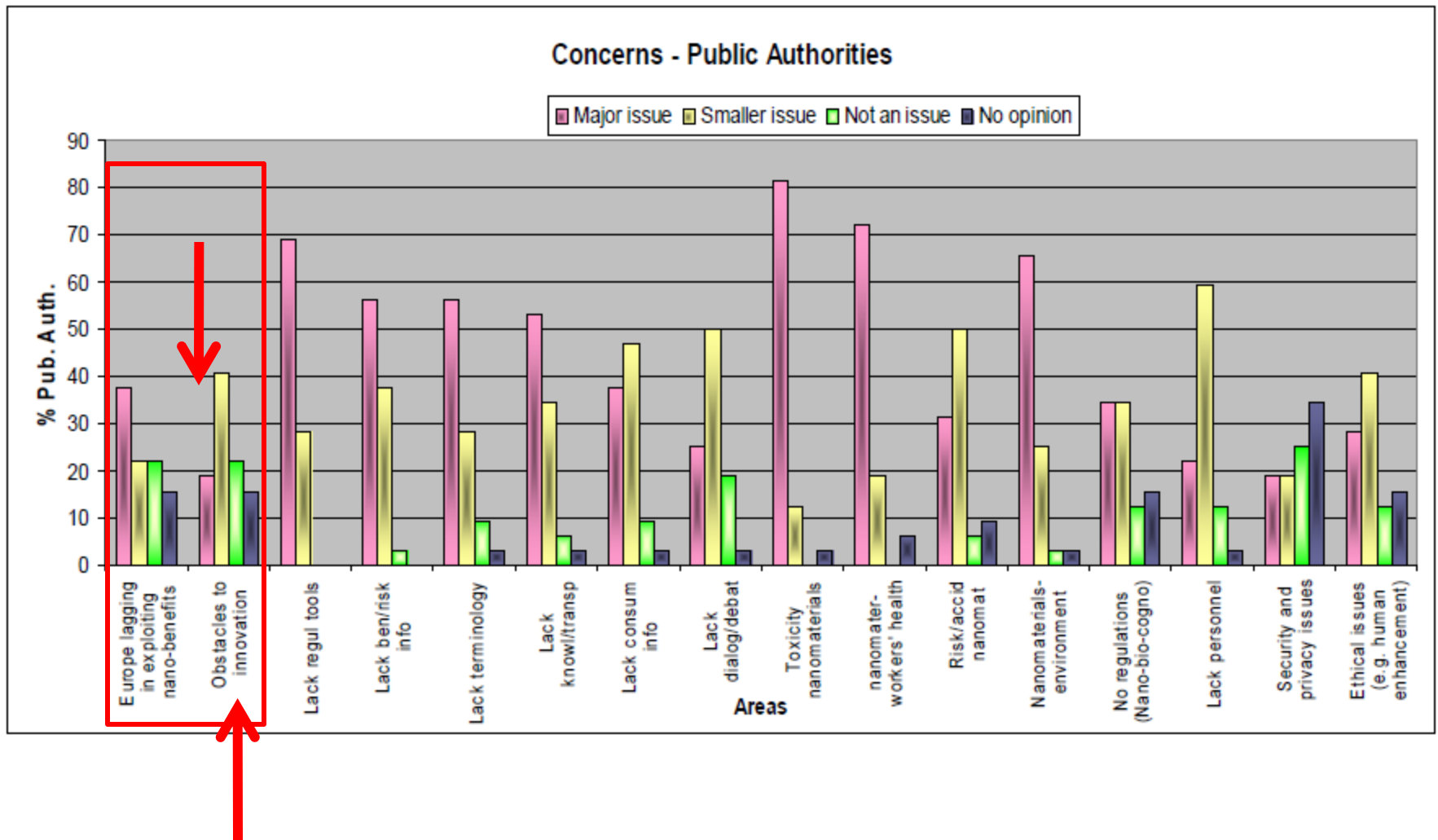
- Industrial funding and participation seriously lags behind government outlays
- Growing inter-disciplinarity of research, product development and commercialization
  - Nano – Bio – Info
    - Traditional European academic disciplines and communities still have difficulty bridging domain boundaries, and finding effective mechanisms for collaboration
    - Current research dominated by science vs engineering cttys
- Dysfunctional European innovation ecosystem
  - Technology transfer and IPR regimes
  - Venture finance
  - Small markets => slow growth, few exits
  - Management talent
- Public concerns about safety, ethics & governance of nanotech

# Industry concerns about the current state of development of nanotechnologies

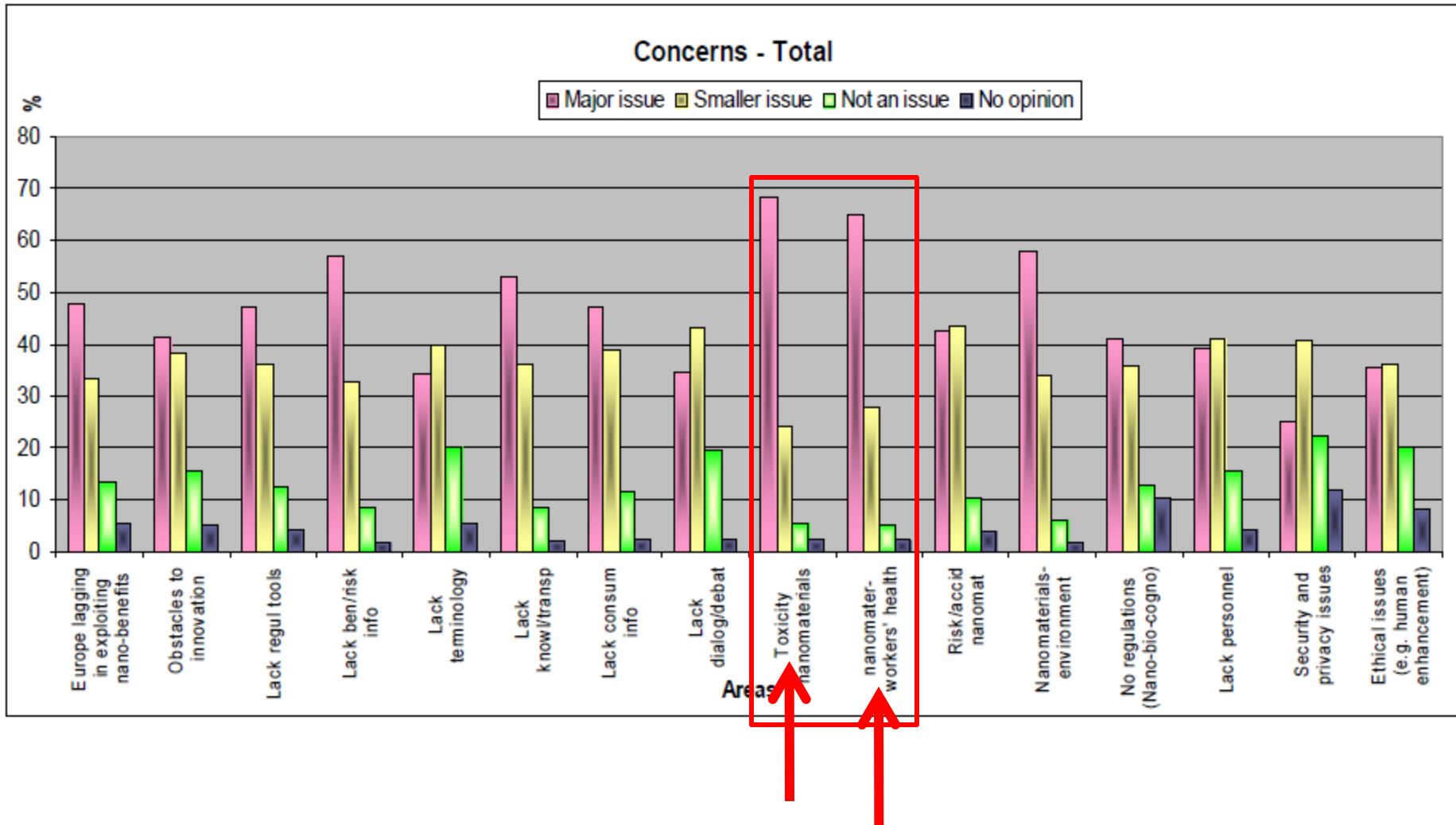


Source: Report on the European Commission's Public Online Consultation:  
TOWARDS A STRATEGIC NANOTECHNOLOGY ACTION PLAN (SNAP) 2010-2015

# Public authority concerns about the current state of development of nanotechnologies



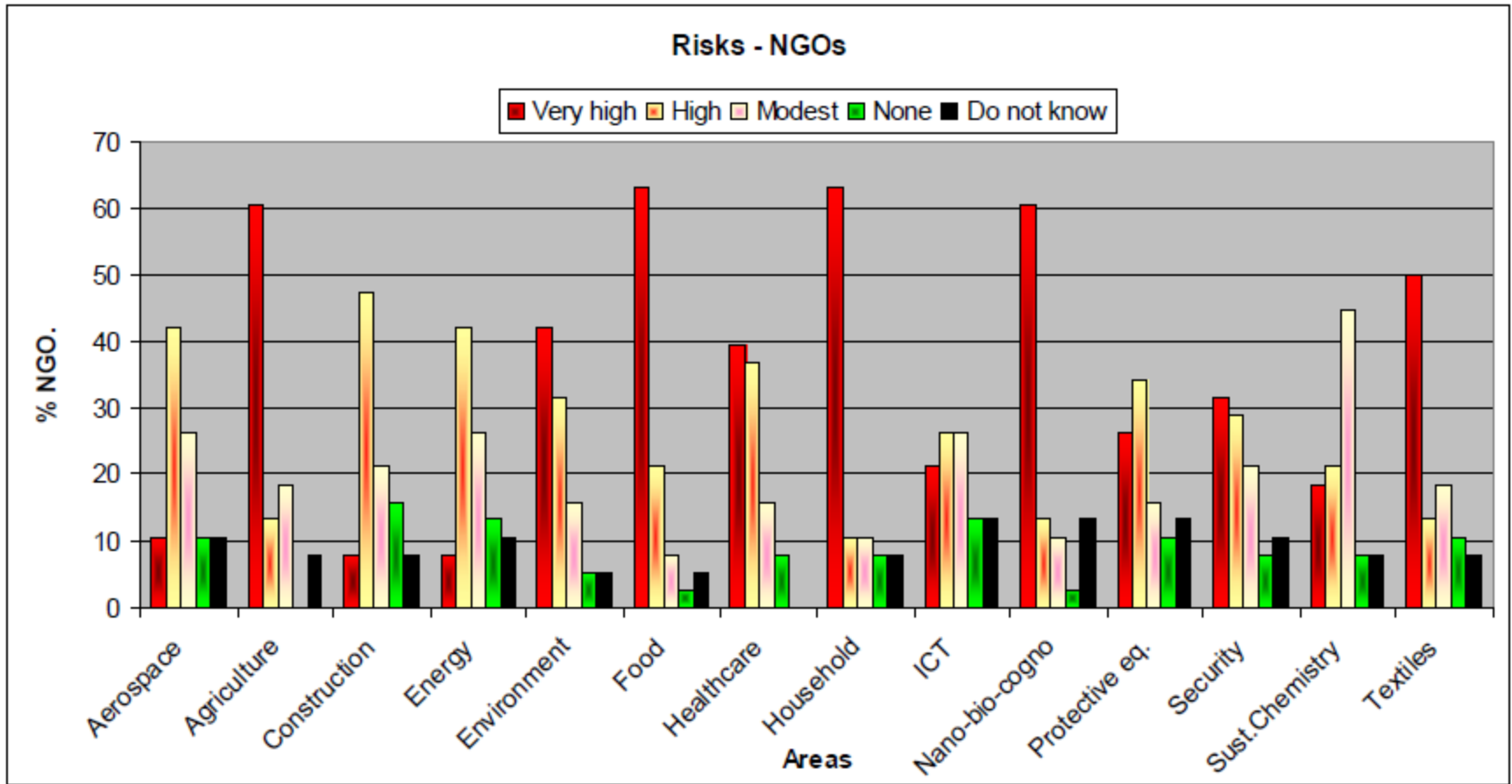
# Public concerns about the current state of development of nanotechnologies



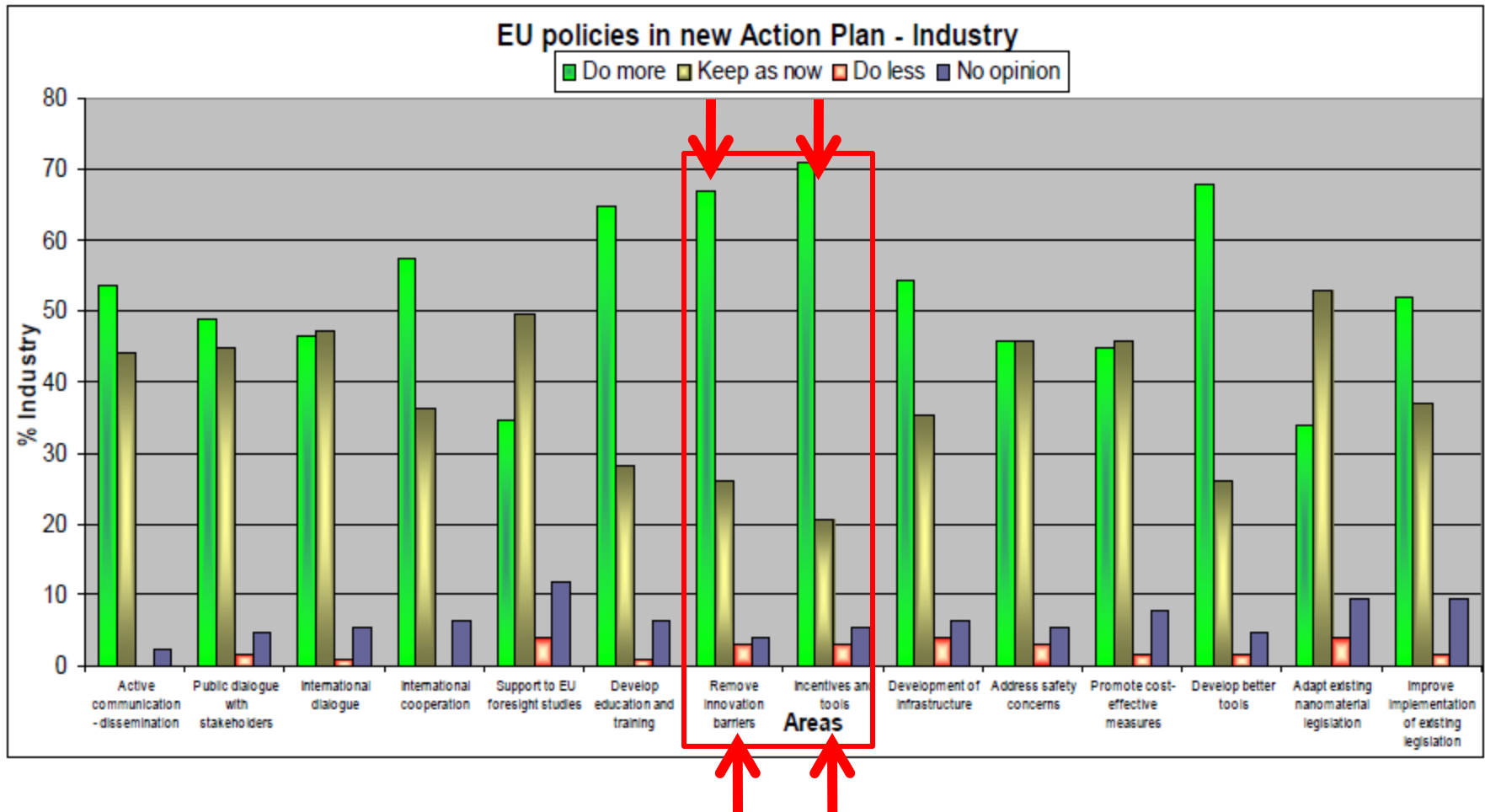


# Perceived risks due to nanotechnologies

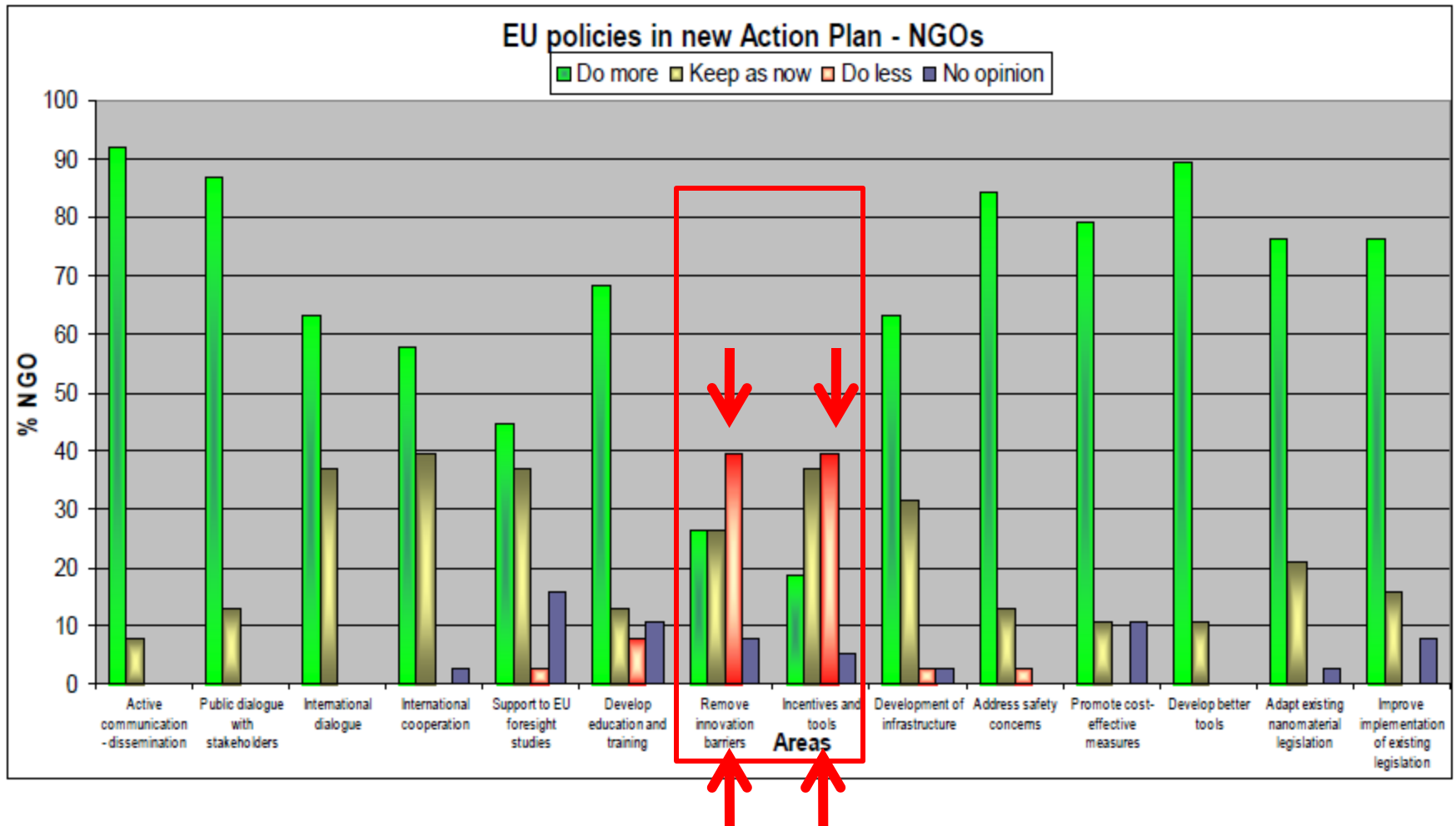
## Non-Governmental Organizations



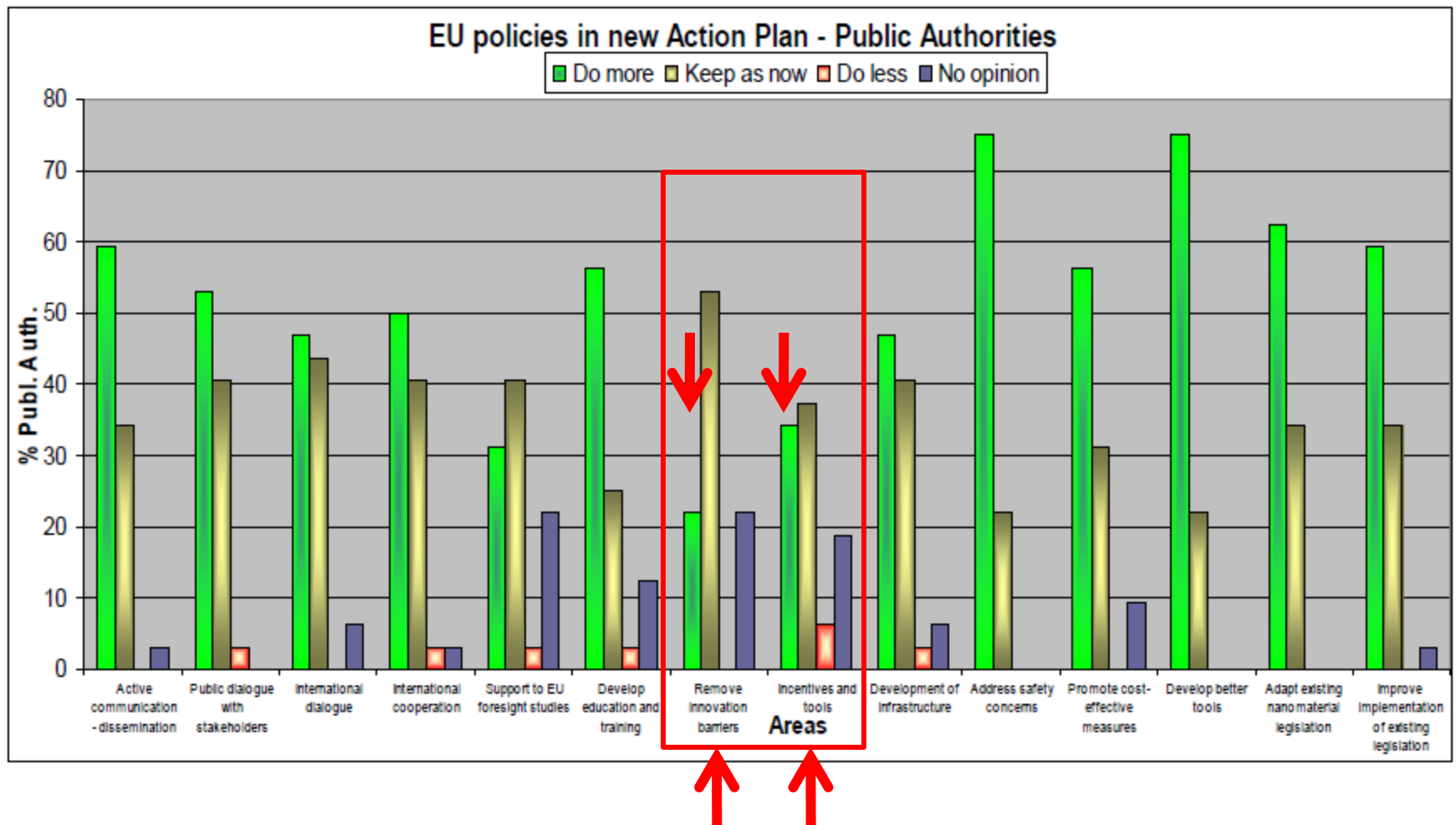
# Industry recommendations wrt new EU policies towards nanotechnology development



# NGO recommendations wrt new EU policies towards nanotechnology development



# Public authority recommendations wrt new EU policies towards nanotechnology development

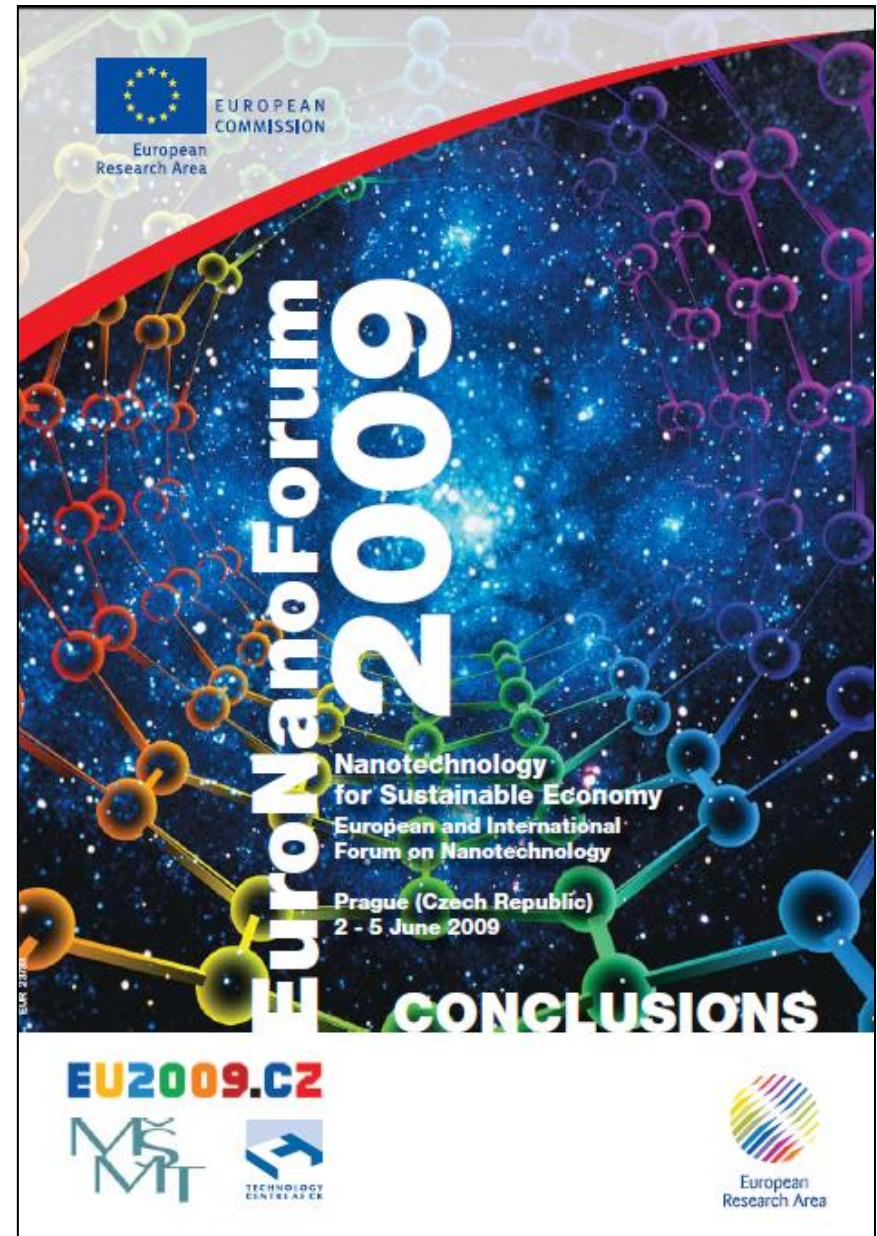


# Summary

- Excellent nanotechnology fundamental research
  - Nano-electronics
  - Photonics
  - Nano-medicine
  - Energy and catalytics
- Primary focus
  - Basic research, fundamental science
- BUT the global image and impact of Europe in the field of Nanotechnology is rather low
  - Poorly functioning system of transferring research to industry and commercial products

# Selected References

- **EuroNanoForum2009 -  
*Nanotechnology for a  
Sustainable Economy:  
European and International  
Forum on Nanotechnology***
  - Conference proceedings  
& conclusions
    - <http://cordis.europa.eu/nanotechnology/src/euronanoforum.htm>



# Selected References



European Commission  
**Nanotechnology**

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**Introduction to nanotechnologies**

Introduction

The Policy

Key areas

Dialogues

FAQ

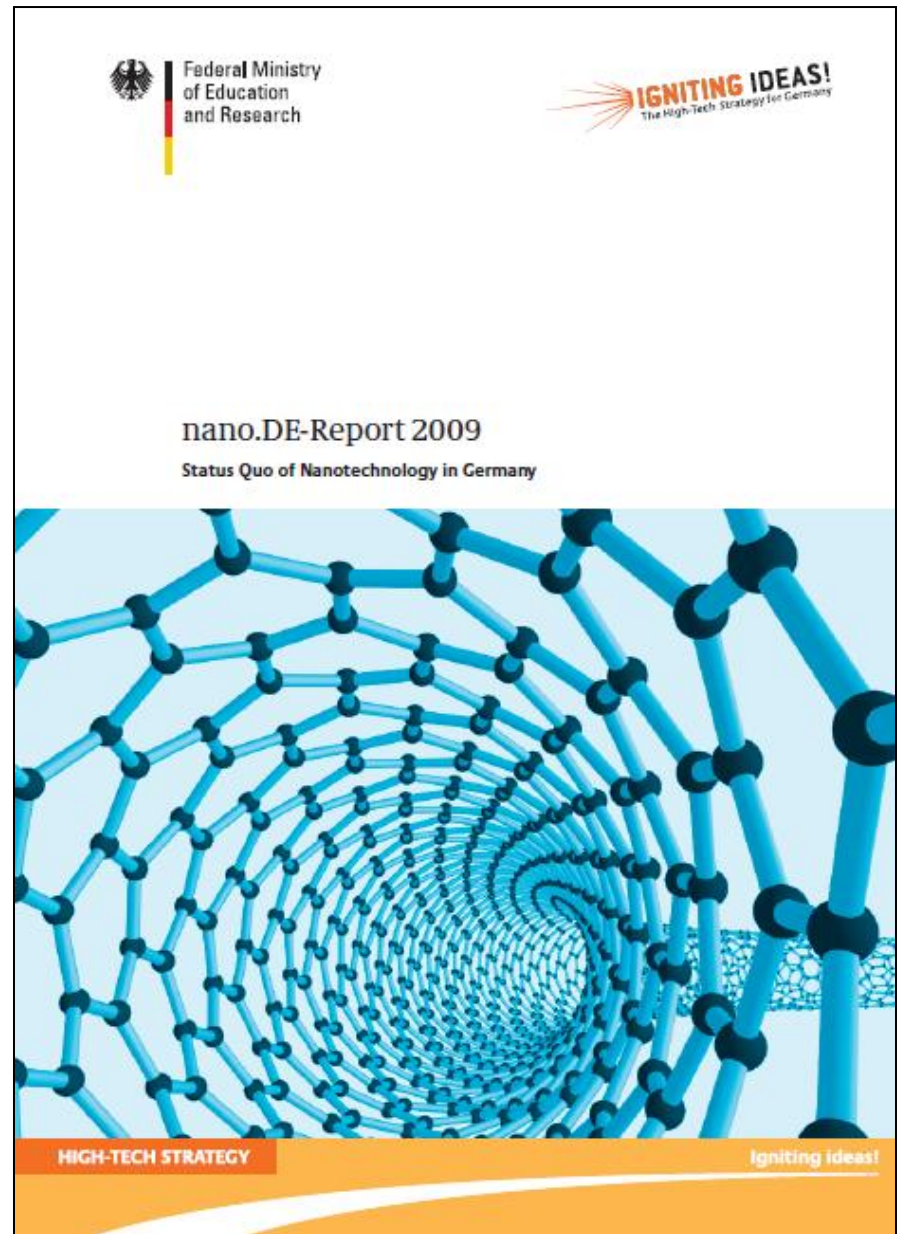
**Public consultation on the needs for EU action related to Nanotechnologies**  
The Commission is inviting experts as well as the public at large to give their views on the needs for EU action related to nanotechnologies in the next five years.  
To participate in this public consultation, click here:  
[http://ec.europa.eu/research/consultations/snap/consultation\\_en.htm](http://ec.europa.eu/research/consultations/snap/consultation_en.htm)

**Introduction**  
  
Nanotechnology is the study of phenomena and fine-tuning of materials at atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale. Products based on nanotechnology are already in use and analysts expect markets to grow by hundreds of billions of euros during this decade. These advances can contribute to the European Union's growth, competitiveness and sustainable development objectives and many of its policies including public health, employment and occupational safety and health, information society, industry, innovation, environment, energy, transport, security and space.  
  
**Nanotechnology research portal of the European Commission**  
  
[CORDIS website portal on nanotechnology research on European level](#)  
  
It offers website access to funding opportunities and EU funded projects, information on international co-operation, financing and innovation, education and mobility, health, environment and safety aspects, and communication and debate. The site also includes publications and events in nanotechnology, the latest nano-related news, and press material on nanotechnology in general and on specific funded projects. It also presents information on the European Strategy and the Action Plan on nanotechnology.



# Selected References

- **Nano.DE Report 2009**
  - Status Quo of Nanotechnology in Germany
  - [http://www.bmbf.de/pub/nanode\\_report\\_2009\\_en.pdf](http://www.bmbf.de/pub/nanode_report_2009_en.pdf)





# Q & A