Mars and Venus
How Europeans and Americans View and Use Science

Part 1: The European Perspective

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Introduction

Introduction: historical perspective

1543: Europe's "Scientific Revolution"
Nicolas Copernicus and *De revolutionibus orbium coelestium*
Andreas Vesalius publishes *De humani corporis fabrica.*

Late 18th Century: Industrial revolution begins in Great Britain

Early 20th Century: From quantum mechanics to nuclear fission

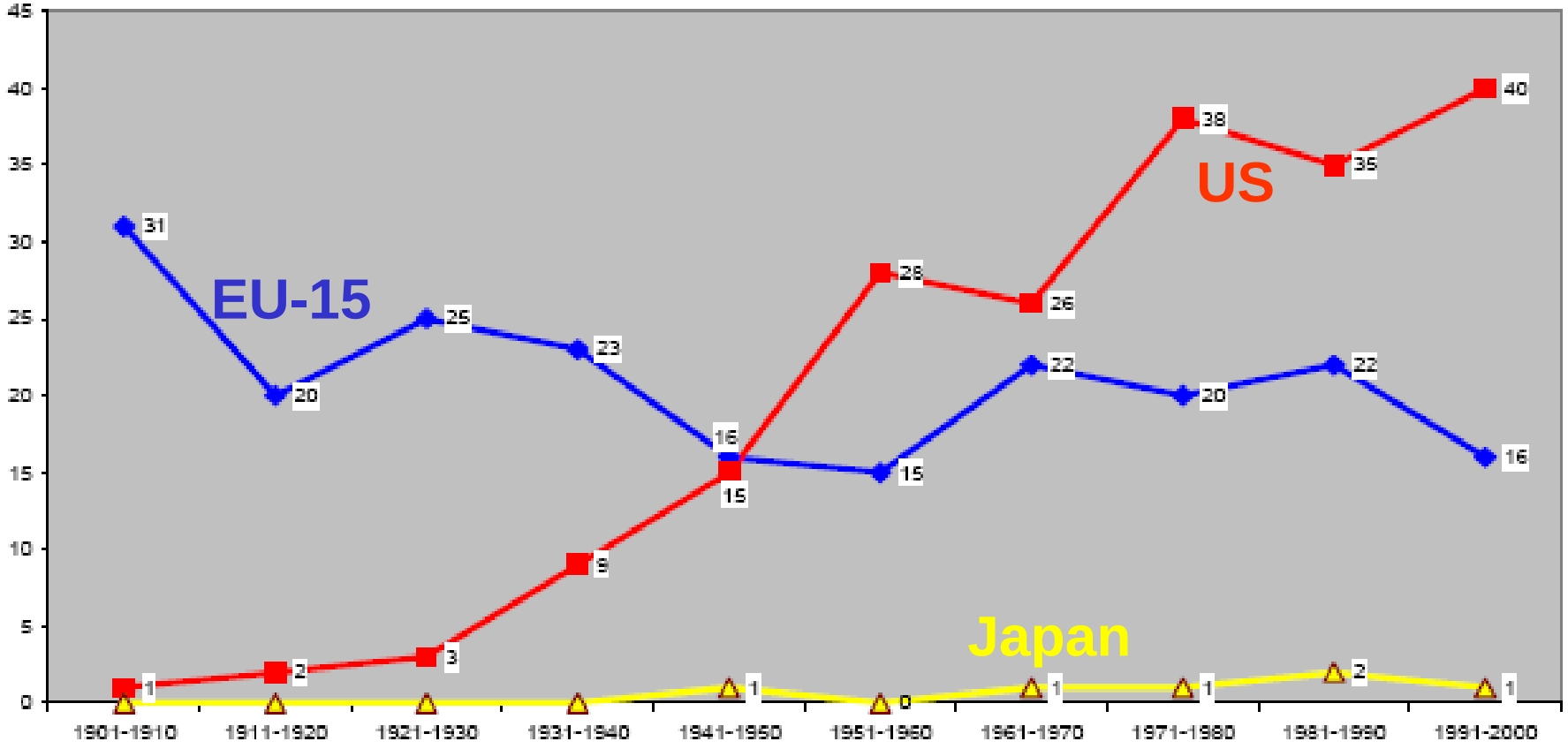
Today: Although the EU produces 38% of the world's scientific knowledge, its impact falls behind that of US research. **Why the change?**

American Civil War: cleared the way for the first **giant common market.** Europe persists as small closed markets for another hundred years. Our integration has only just begun.

World Wars I & II: European populations decimated, investment dominated by defence and reconstruction, significant emigration drains scientific talent.

Changing pre-eminence

Number of **Nobel Prizes** in chemistry, physics, medicine or physiology by ten year periods, EU-15, US, Japan, **1901-2000**



Source: European Commission, Communication on Europe and Basic Research, 2004

1. Europe’s response to today’s challenges

Creation of the European Economic Community (1958)

The making of a come-back:

- ✓ **Peace.** The creation of an **internal market.** Preparation for **globalisation.** Huge **economies of scale**. Continuous enlargement and **harmonisation. Growth** of Western Europe's GDP **from half of that of US to overtake it as world's largest economy** (source: IMF 2007)

The Lisbon Strategy (2000)

Next step: make EU world's most dynamic **knowledge-based economy** by 2010

- ✓ Sustainable economic **growth**, more and better **jobs** and greater **social** cohesion, respect for the **environment**. The creation of a level playing field…

Key pillar: The European Research Area (ERA)

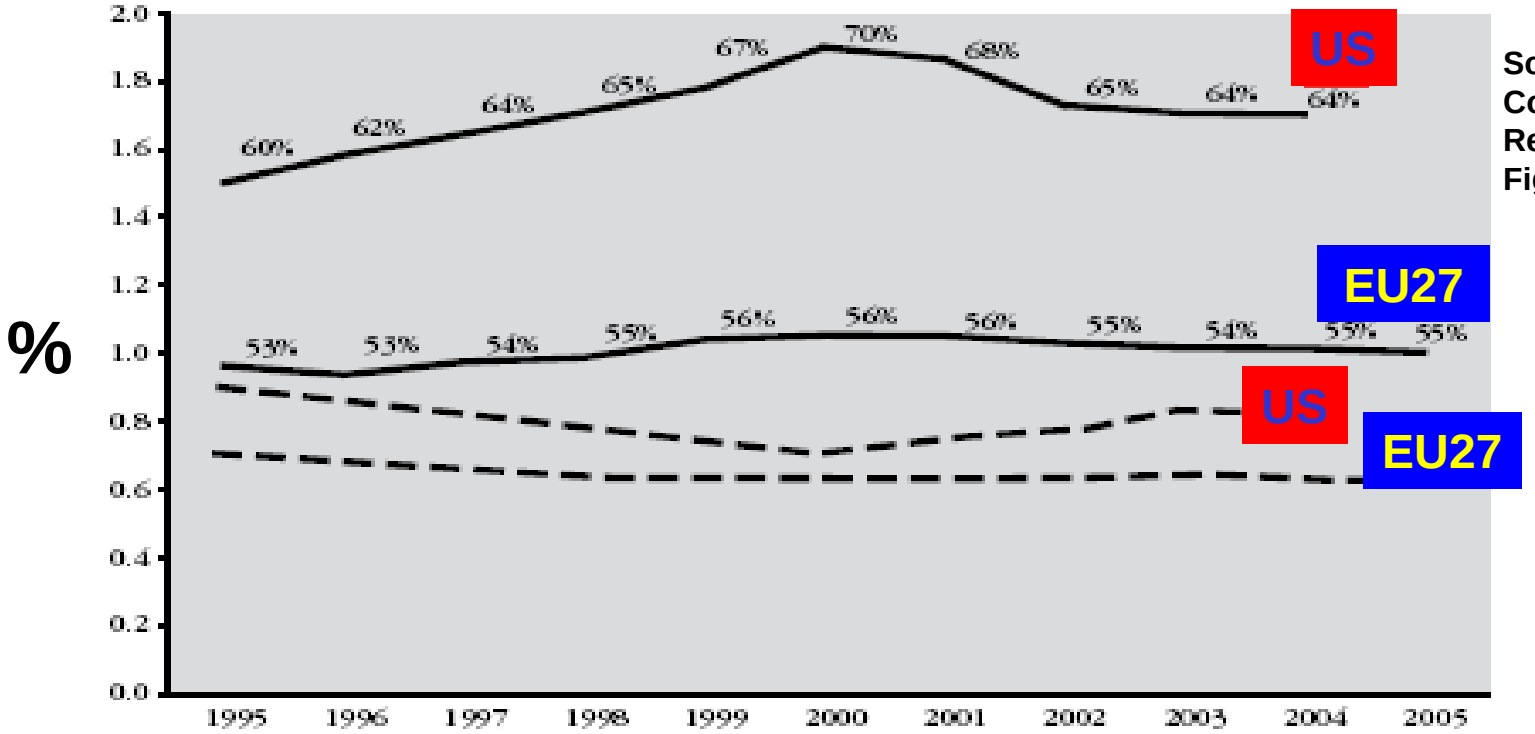
A new common market for research and innovation in the EU:

- ✓ **Frontier-free** European research with a renewed focus on **excellence**
- ✓ Well-**coordinated** research programmes & priorities
- ✓ Adequate **flow** of competent researchers
- ✓ World class research **infrastructures and institutions**
- ✓ Effective **knowledge-sharing**
- ✓ A European Research Area **open to the world**

Europe's response: financial investment in R&D remains low

Investment / year	1995	2005	Increase
US (ppp billions of $)	184	313	**70%**
EU27 (ppp billions of $)	139	228	**63%**

GERD financed by business enterprise and by government as % of GDP, 1995-2005



Source: European Commission, DG Research Key Figures 2007

Europe's response: better governance of R&D

Imagine a USA in which the Federal government managed **only 5% of overall R&D expenditure** with 95% managed individually by 50 independent states…

Nevertheless… Progress made. Since 1984:

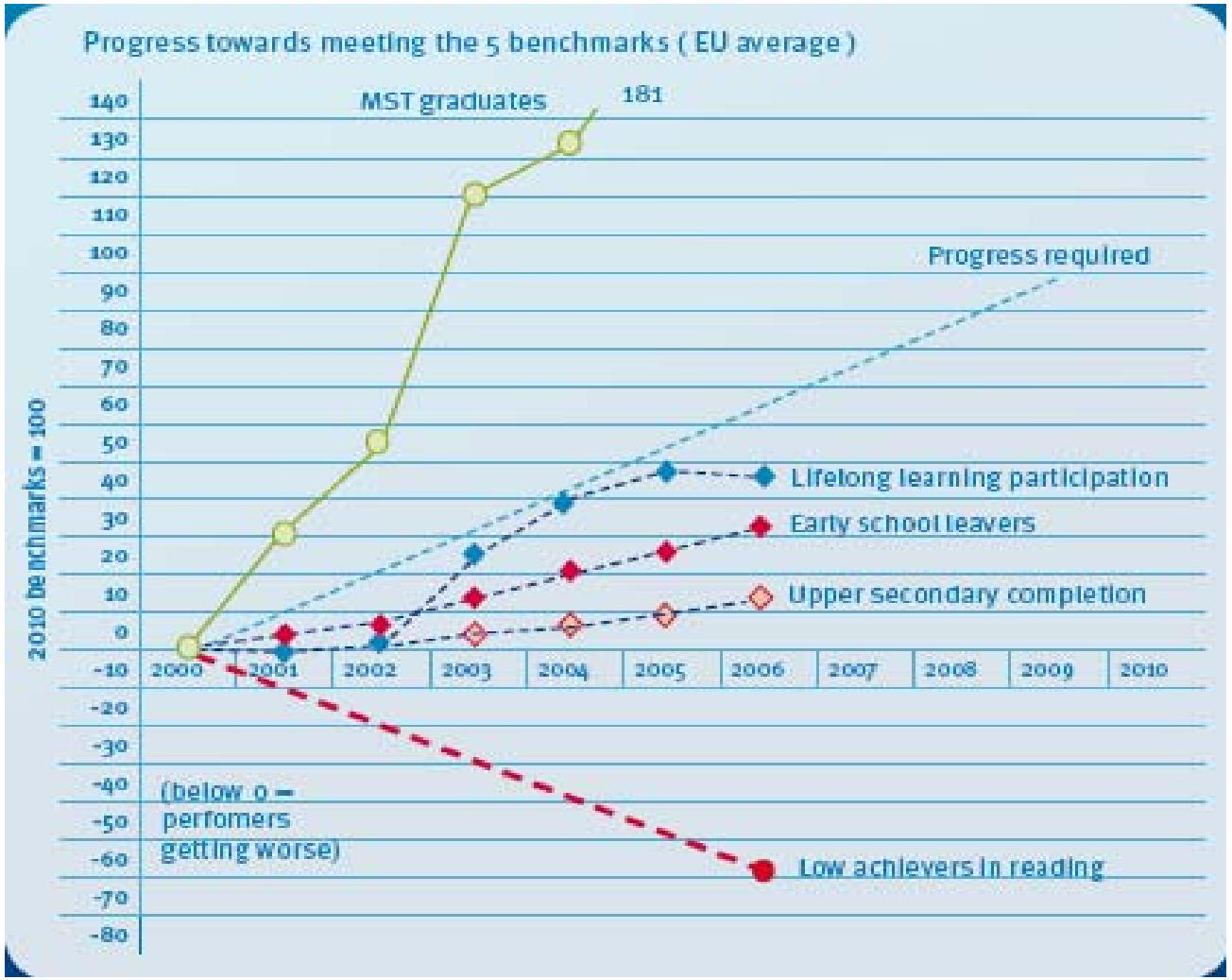
- ✓ EU-Framework programmes, collaborative research, **Article 169**
- ✓ European Research Infrastructure Initiative,
- ✓ European Research Council (ERC)
- ✓ European Institute of Technology (EIT)
- ✓ EU Research funding increased from €5 to €10 billion/year

Reform of Member States' Research Institutions

- ✓ Excellence initiatives: more autonomy and flexibility, more competitiveness, more performance based evaluation
- ✓ Better harvesting and measurement of the benefits of higher education
- ✓ More entrepreneurial spirit, private-public partnerships
- ✓ Less red tape

Europe's response: good news on education

Five Education Benchmarks for Europe: Trends 2000-2006/7



Presentation of progress made towards Member States' 2010 education goals against 5 key benchmarks.

The curves show relative progress in each benchmark.

Progress required to reach the benchmark in 2010 is set at 100.

Source: European Commission, DGs EAC and JRC

2. The EU and the US: how we compare

How we compare: scientific output

EU is the world's largest producer of scientific output

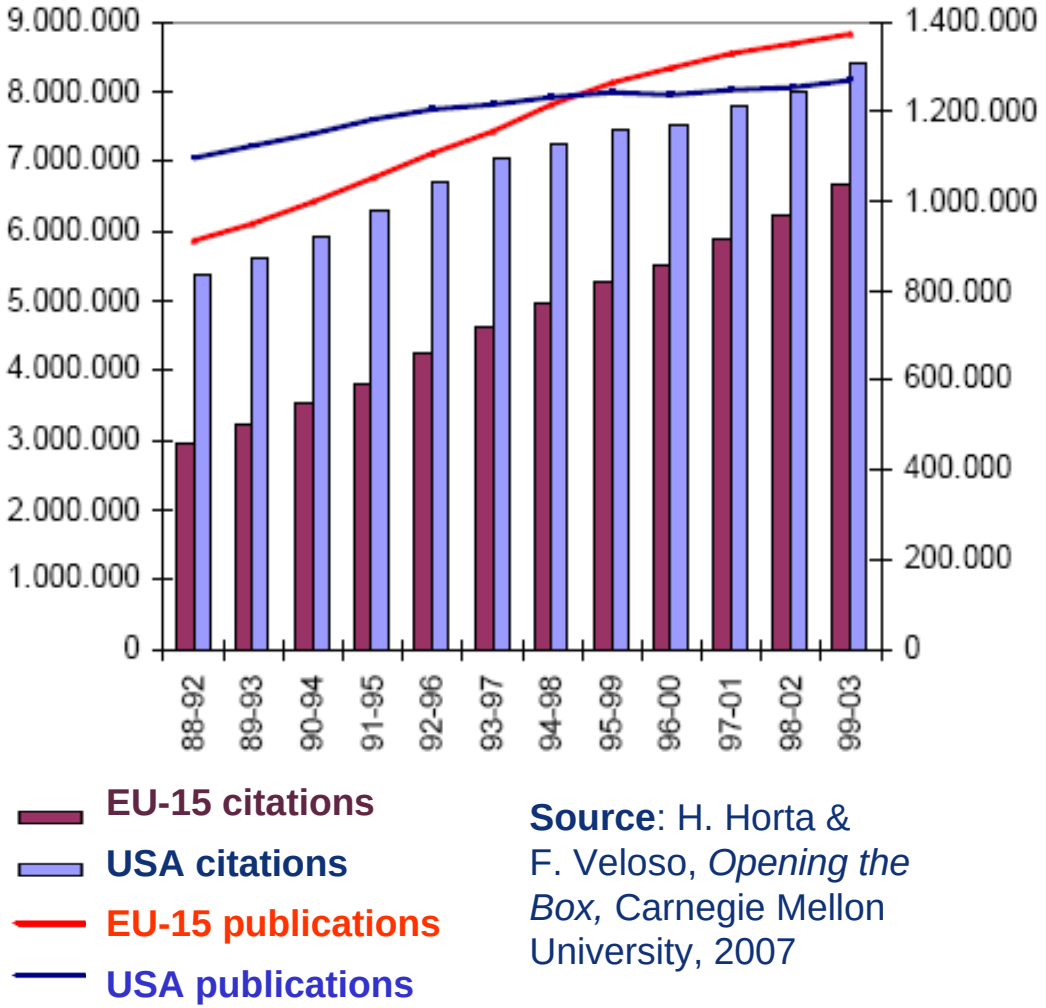
Share in world total of peer reviewed scientific articles:

1. **EU: 38 %**
2. **US: 33%**
3. **Japan: 9 %**
4. **China: 6%**

Challenges: **US** produces significantly more scientific **publications per million population** and per university researcher.

EU also **behind** in terms of **overall citation impact.**

EU-15 and US publications and citations 1988/92 - 1999/03



Source: H. Horta & F. Veloso, *Opening the Box,* Carnegie Mellon University, 2007

How we compare: investment and impact

EU scores best in 'traditional' scientific fields (chemistry, astronomy, pharmacology, mathematics, physics and the engineering sciences) but **lags behind the US in new, fast-emerging fields**.

US produces world's most visible research overall, but **Europe leads in certain key fields** such as **'energy'** and 'materials science'.

Scientific output more dispersed across scientific disciplines in the EU than in the US. Scientific output (measured by scientific publications) more evenly distributed across all fields of science in EU.

Green innovation and technology: EU is world leader in **renewable** energies. Annual industry turnover of **€30 billion** and 350,000 jobs.

Venture capital investment: US almost **40% ahead** of the **EU** in **total investment** and **64%** in **early stage investment** (2005).

Source: European Commission, DG RTD Key Figures 2007
OECD, Main Science and Technology Indicators, May 2007

How we compare: university research

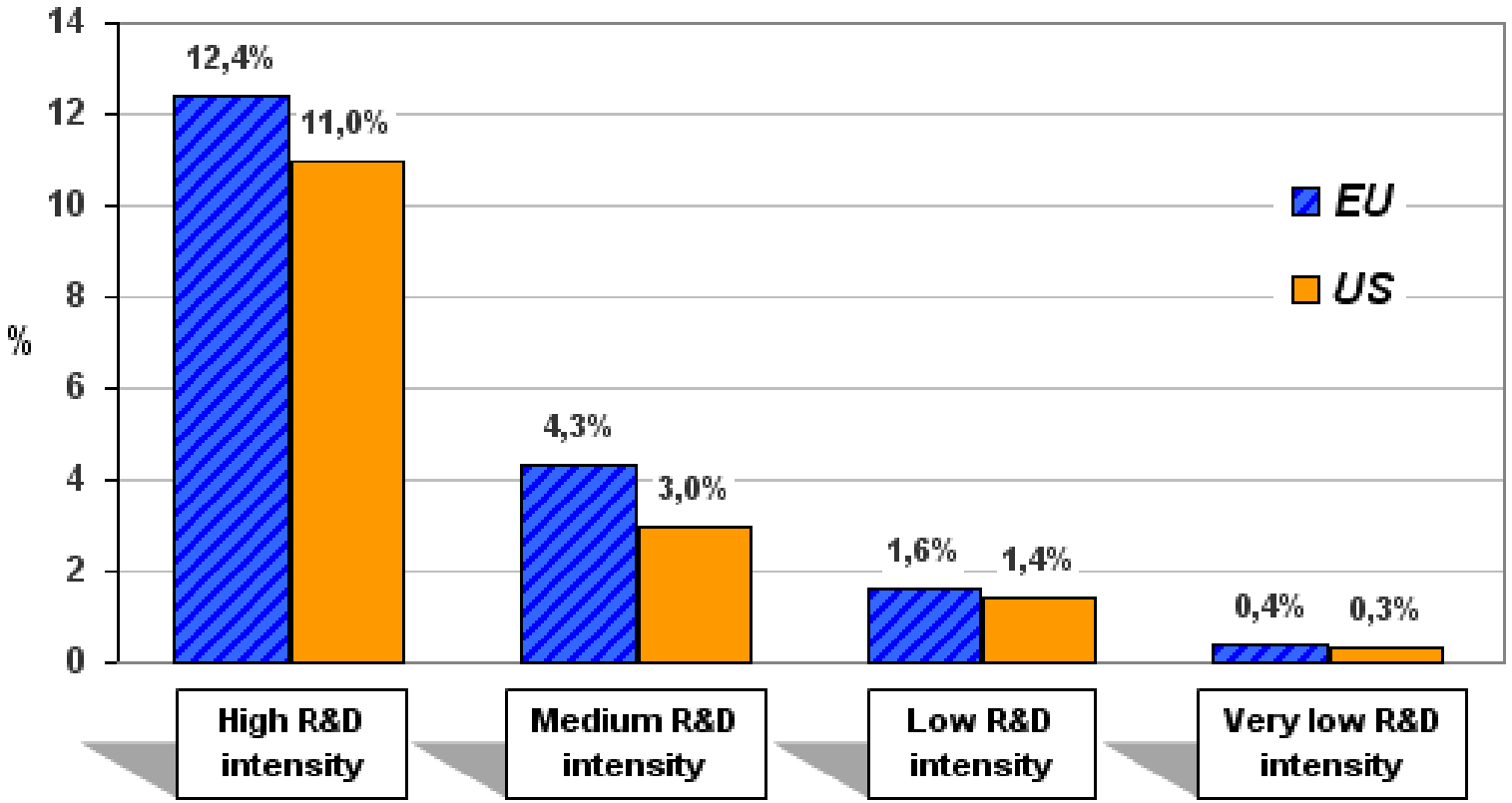
- Out of the 25 **most active* research universities** in the world, 80% are located in the US.
- But out of the 386 most active research universities in the world, **45% are located in Europe** and 32% in the US.
- EU-27 produces nearly **twice as many science and engineering university graduates** as the US (850,000 against 430,000) and more than **twice its S&E doctoral graduates** (41,000 against 19,000).

* Universities that published more than 5000 scientific papers over 1997-2004 period.

Source: European Commission, DG RTD, JRC
ERAWATCH network ASBL (2007)
CWTS, Leiden University (2006)

How we compare: the industrial R&D intensity paradox…

EU companies are **more R&D intensive** than US companies when looked at sector-by-sector. But on aggregate, US industry is more R&D intensive*.

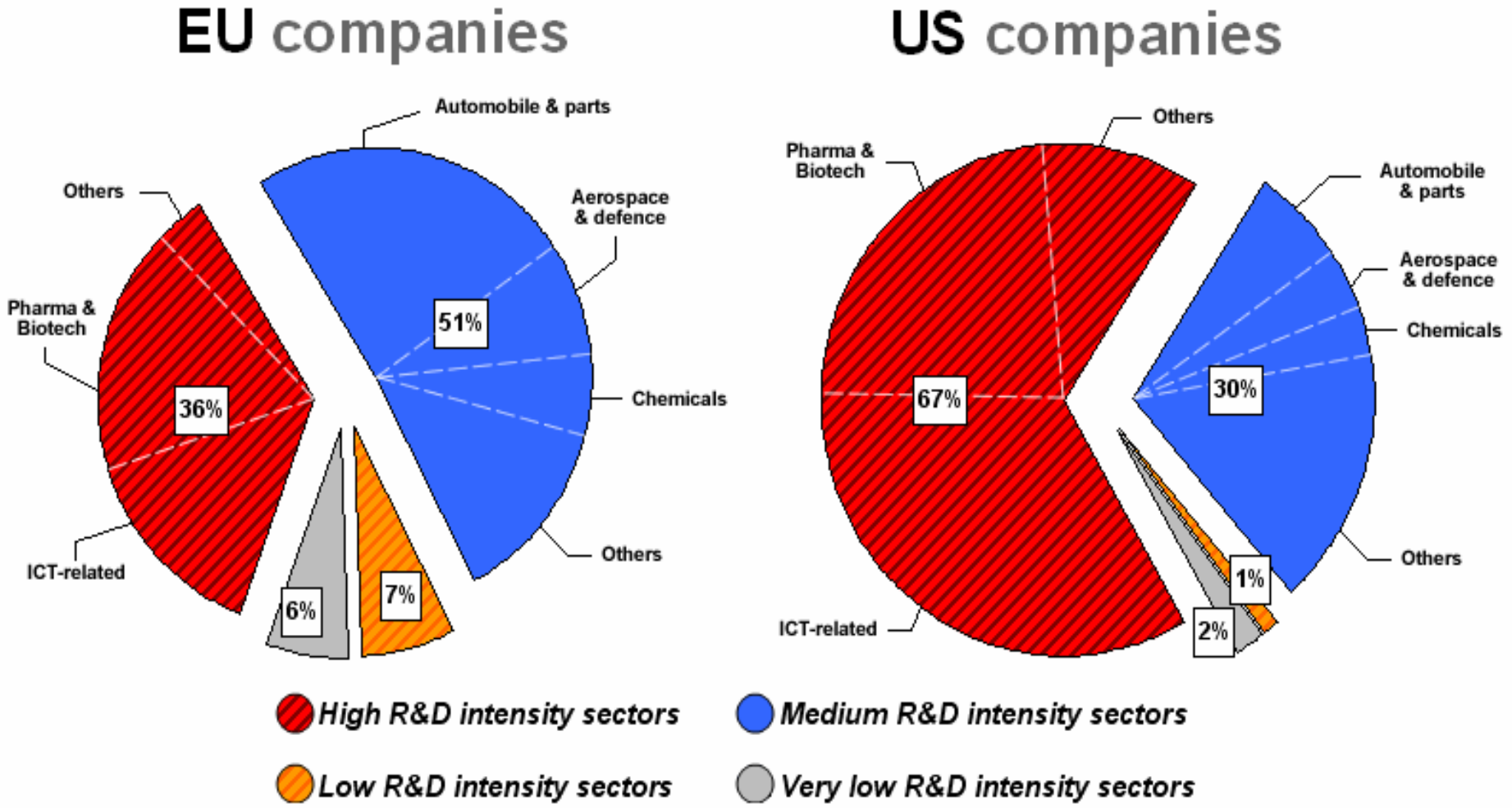


*** Intensity: R&D investment as % of sales**

Source: The 2006 EU Industrial R&D Investment Scoreboard

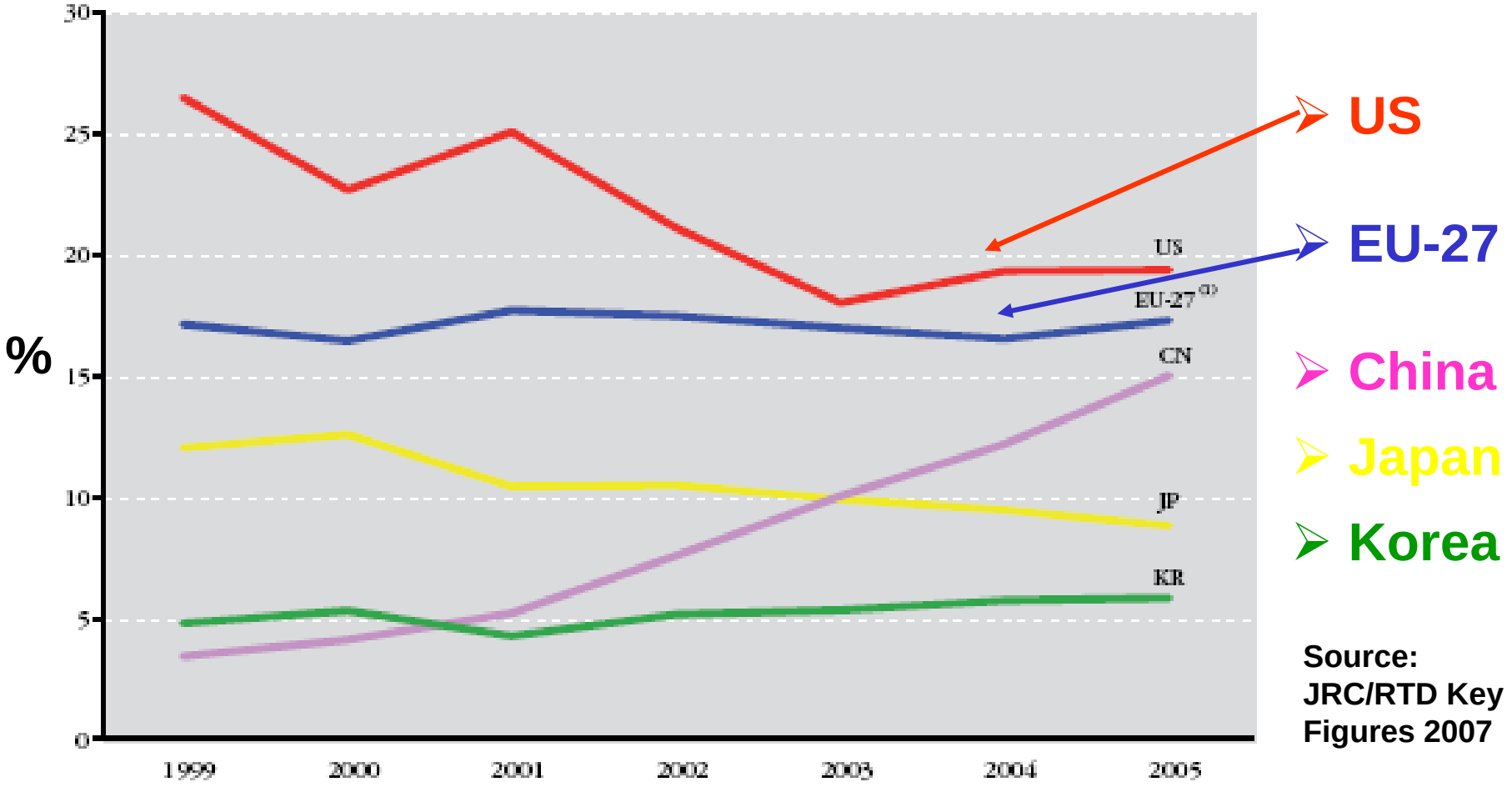
(How we compare) … due to different industrial structures

Weight of high R&D intensive industrial sectors much higher in the US



Source: 2006 EU Industrial R&D Investment Scoreboard

Exports of high-tech products: world market shares, 1999-2005



Source: JRC/RTD Key Figures 2007

3. Transatlantic relations: competition and collaboration

EU-US relationship: a unique partnership

EU-US: A **unique relationship** as international partners. **Common values.** The **largest** bilateral **trade** relationship in the world.

Competition provides healthy stimuli, **collaboration** opens endless possibilities.

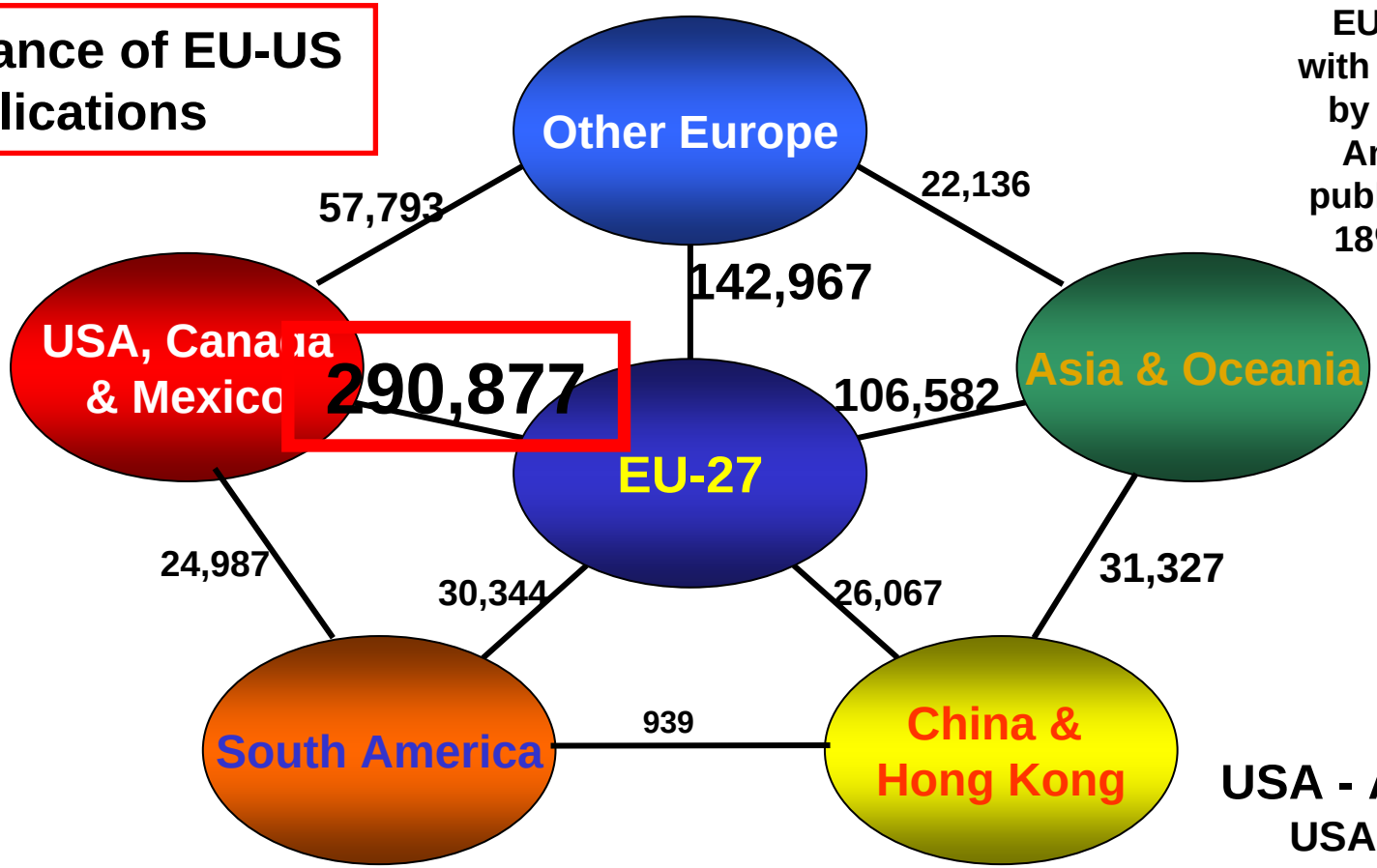
Strength of these **interactions**: research and development expenditures by European-owned firms in the U.S. reached $18.6 billion for the year 2000, while spending by U.S. firms in Europe totalled $12.9 billion.

In 2004, the US and the EU signed a **five-year renewal of their 'Agreement for Scientific and Technological Cooperation'.** U.S. also has bilateral agreements with many individual European countries.

Strong basis of cooperation in areas such as **nano and biotech or nuclear research. G**reat **potential** for cooperation to be developed in areas including **health, climate change, research mobility and energy**.

Co-publications between world regions, 2000-2006

Dominance of EU-US co-publications



EU co-publications with China increased by 15% while North America/China co-publications rose by 18% over the 2000-2006 period

Other links:

USA - Asia: 134,771
USA - China: 35,976
Asia - South America: 5,200
Other Europe - China: 4037
Other Europe - South America: 3730

Source:
European Commission, DG Research

Transatlantic relations: researchers' mobility

It is estimated that there are **over 400,000 European researchers working in the US.**

Facilitating mobility: *EURAXESS – Researchers in Motion*

EURAXESS Jobs: A European researchers mobility portal with information on research training, jobs and mobility in 32 associated countries.

EURAXESS Services: European Network of Mobility Centres providing assistance to researchers and their families from all over the world moving to work in Europe.

EURAXESS Rights (European Charter & Code): set out the rights and duties of researchers and their employers

EURAXESS Links: A network of thousands of European researchers, scientists and scholars in the USA. Members kept informed of EU research policies, opportunities for work in/collaboration with Europe.

http://ec.europa.eu/euraxess/index_en.cfm

Source: European Commission, RTD Key figures 2007

4. European views of science

European views of science and technology:
The Precautionary Principle

A key defining feature of the European approach today:
Application of **the precautionary principle.**

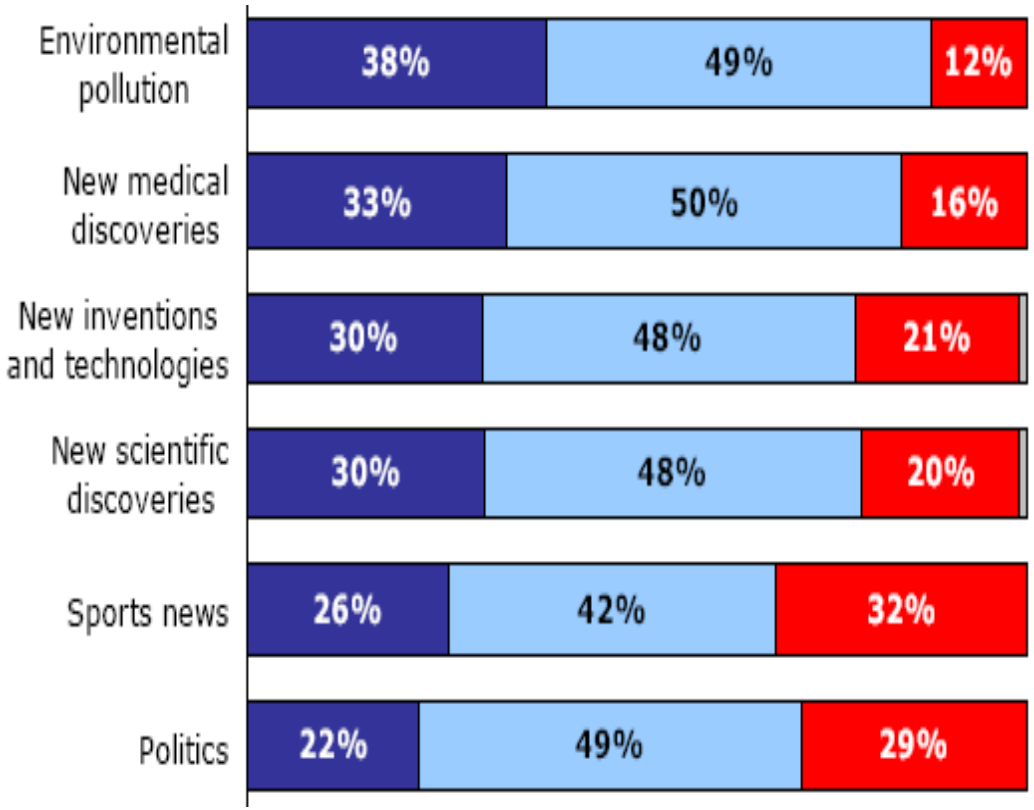
"If an action or policy might cause severe or irreversible harm to the public or to the environment, in the absence of a scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action."

Precautionary principle also because the EU is not one country like US. **Plurality of visions** means **more time** required to arrive at a **consensual position**. EU spends more time on preparatory phase. We discover the negative implications of new technologies **first** and take them into consideration.

Policy decisions **must be based on robust science.**

European views of science: public interest and opinion

European Citizens' levels of interest in news themes (Eurobarometer 224, 2005)



European Concerns

✓Long-term quality of products
✓Environmental impact, sustainability
✓Long term results, impact (rather than short term)
✓Risk management/awareness
✓International relations
✓Team spirit over individual success
✓Legal and social security
✓Cultural heritage and tradition, diversity

EU citizens are generally well informed, concerned regarding the socio-economic, environmental or ethical impact of scientific progress. Sometimes sceptical, but they care.

Transatlantic differences in public opinion?

Views of biotechnology

- **In 2005**, 71% of Americans **expressed support for** products and processes involving **biotechnology.**
- **Almost** two-thirds of **Europeans** also said they expected **biotechnology** to **positively affect** their way of life in the next 20 years.

Views of nanotechnology

- When told about **nanotechnology,** about **half** of **Americans** surveyed in 2005 foresaw substantial or some **benefit** from it, and 14% expected substantial or some **risk.**
- Among Europeans, 48% expected **positive effects** from **nanotechnology**, whereas **only** 8% expected **negative** effects**.**

5. European use of science: three policy illustrations

Climate change, Nanotechnology, Chemicals

European use of science (1a): Climate Change

European Council, March 2007: Union adopts strategic objective to limit global warming to **no more than 2º** Celsius above pre-industrial levels.

"3 times 20" objectives for 2020:

- **-20% greenhouse gas emissions,**
- **+20% improvement in energy efficiency**
- **with 20% coming from renewable energy sources.**

Research is key to the EU's strategy for dealing with climate change. **Key in mitigation (above) and also in** adaptation measures…

Energy: A Strategic Energy Technology-Plan (SET-Plan) adopted 2007 to **accelerate innovation** of low carbon energy technologies and encourage European industry to turn threats of climate change and insecurity of supply into opportunities to increase competitiveness.

European use of science (1b): Climate Change

Adaptation to climate change:

EU at cutting edge of research investigating initiatives and measures to reduce the **vulnerability** of natural and human systems against **expected climate change effects.**

JRC plays a key role: developed a methodology to assess global warming induced changes in the hydrological cycle, consequent socio-economic impacts.

- ex-ante and ex-post analysis of EU policies: mitigation and adaptation
- extended cost/benefit analyses
- develops and applies systems for monitoring the causes and effects of climate change

Chain of Impacts:

The **PESETA project**, led by the JRC: a multi-sector analysis of the impacts and economic costs of climate change in Europe, and adaptation responses regarding flood hazards, fire risk and other elements.

European use of science (2): Nanotechnology

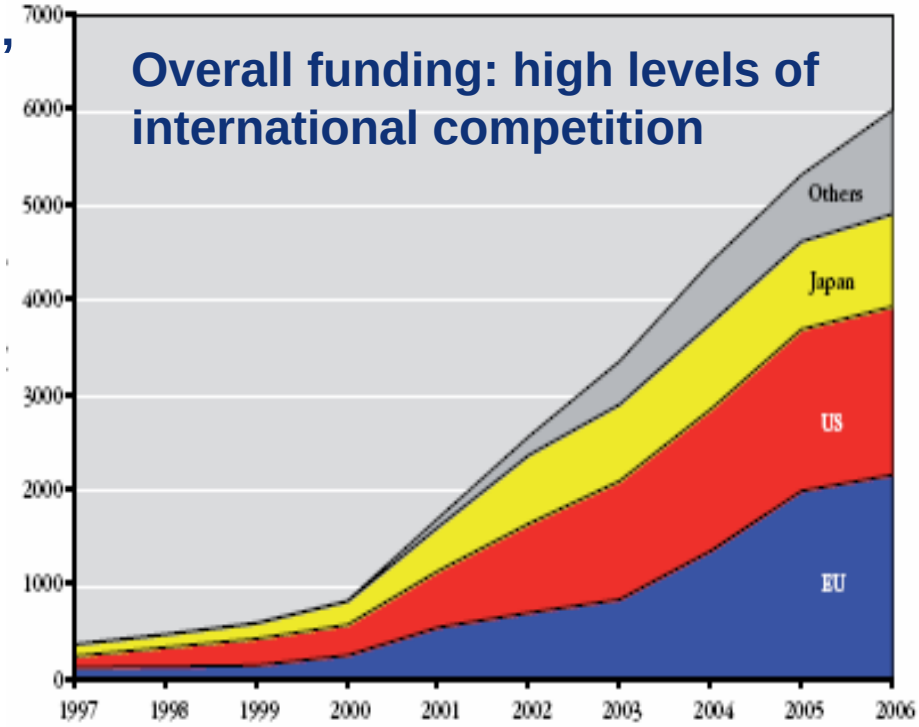
European Commission is the world's largest public investor in nanotechnology.

6th EU Research Framework Programme provided **€1.4 billion to 550 projects** (2004-2006).

The European 'precautionary approach'

EU Member States invest nearly twice as much as the United States in **research addressing the potential environmental, health and safety hazards** of nanotechnologies.

Recent **US study** by the US Project on Emerging Nanotechnolgies (PEN) noted that **comparatively little US government money** spent on control of associated risks.



Source: European Commission, DG Research, Key Figures 2007 / Cordis

European use of science (3): Chemicals (REACH)

Registration, **E**valuation, **A**uthorisation and Restriction of **Ch**emical substances.

EU Regulation (law) came into force on **June 1st 2007.**

Innovation AND **risk assessment**. Protection of humans and the environment.

Creating a **paradigm shift:** making **industry responsible** for our health and safety:

- ✓ **Full responsibility** for the **provision of information and risk assessment** transferred from Member States to **industry**. Full participation by industry in the process.
- ✓ **Different from US approach.** EU leading the field: Norm being **adopted globally**. Japan has adopted regulation.
- ✓ Over **30,000 chemicals** expected to be pre-registered for **continuation on the market**. **Before REACH:** general **lack of knowledge** regarding 99% of the chemicals on the market. (Prior to 1981, no stringent health and safety tests needed to market chemicals).
- ✓ **Availability of information: will now be free for all to access** on the web (outside of EU information remains difficult to obtain).

http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

Conclusions

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EU must continue to increase R&D expenditure, reform in the name of research excellence, competitiveness, business friendly environment.

ERA is essential: Coherence necessary for effective governance of R&D, value for money, in the EU. As the EU becomes more tightly integrated into a European Research Area, it will be more reasonable to compare its overall performance to that of the U.S.

Lisbon agenda showing positive developments

Pioneering spirit and the precautionary approach compliment one another and will continue to do so. **Mutual learning is essential**.

Competition is healthy. **Collaboration** is necessary. Increased cooperation and interaction will facilitate our efforts.

Our **approaches to science** can be different but our most significant **interests** and **goals** are the same.

Presentation available to download:

www.jrc.ec.europa.eu

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