Higher Education and Scientific Research in the Islamic World

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Importance of Higher Education and Scientific Research

- **A modern and high quality education system is a fundamental element in the socio-economic development and prosperity of any society**
  - Constitutes the core of human capital formation
  - Facilitates economic development and growth
- **Research in science and technology is key towards a knowledge-based and innovation-driven economy**
  - Promotes better understanding on different aspects of life
  - Helps to improve the standard of living by creating new knowledge and technological innovation

Content

- What are major indicators of performance at higher education and research?
  - Scientific Publications
  - University Rankings
- What are the key determining factors of performance?
  - Student Teacher Ratio at Tertiary Schools
  - Enrolment Rate at Tertiary Schools
  - Public Expenditure for Tertiary Education
- What are other indicators of science and technology?
  - Human Resources in R&D
  - R&D Expenditures
  - High-Tech Exports
  - Patent Applications
  - Knowledge Indices of World Bank
- What is to be done?

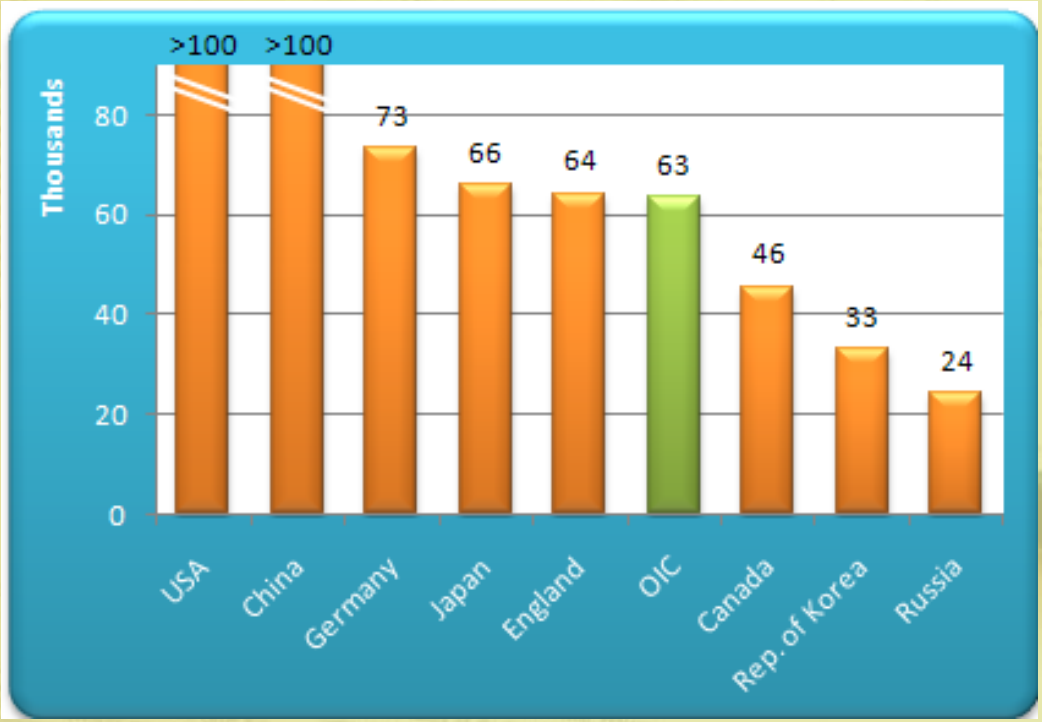
Major indicators of performance at higher education and scientific research

Scientific Publications

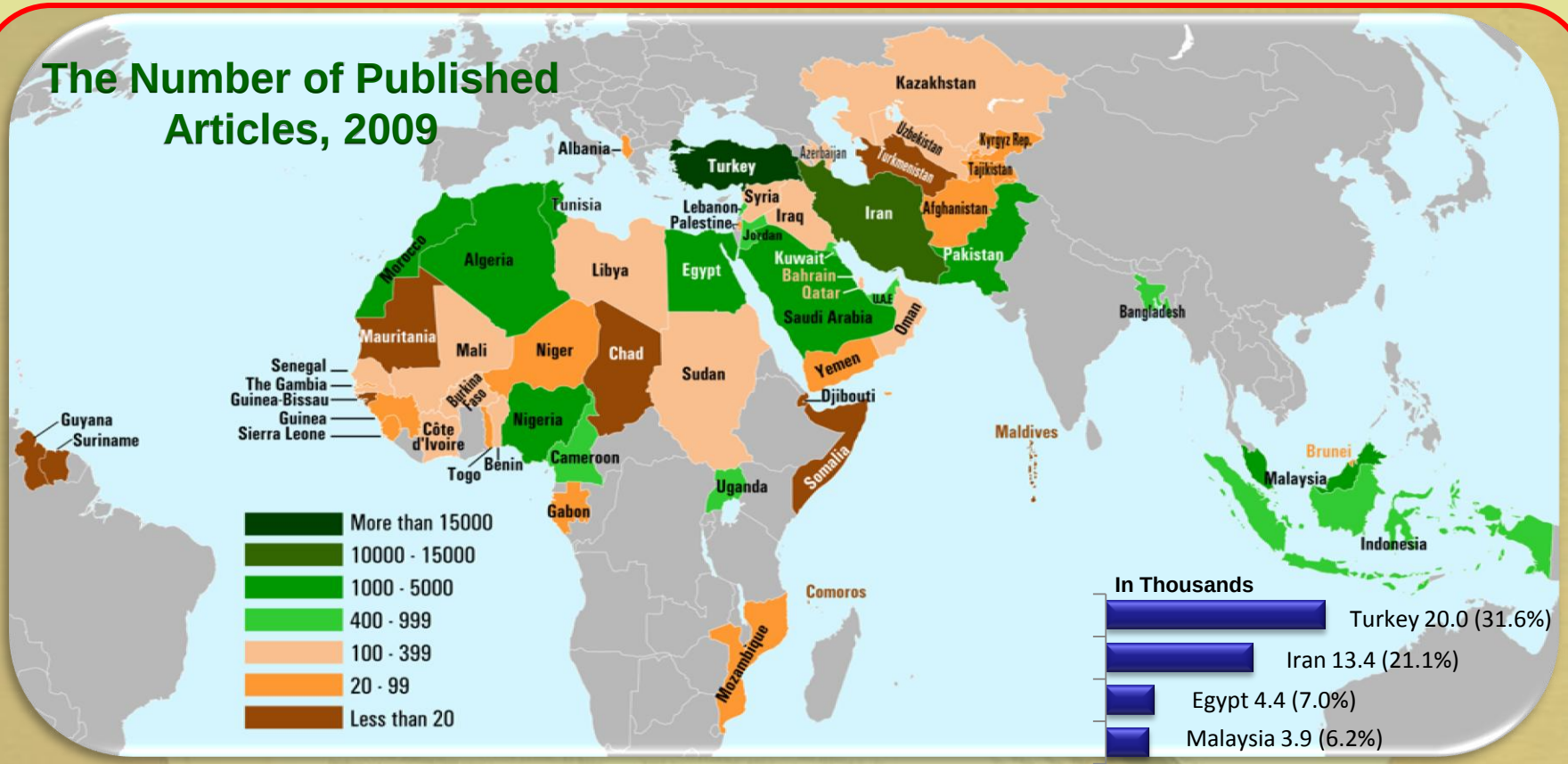
OIC member countries published 63,342 articles in 2009 (compared to 18,391 in 2000) in journals that are covered by

Science Citation Index Expanded
Social Science Citation Index
Arts & Humanities Citation Index

The Number of Published Articles, 2009



Scientific Publications

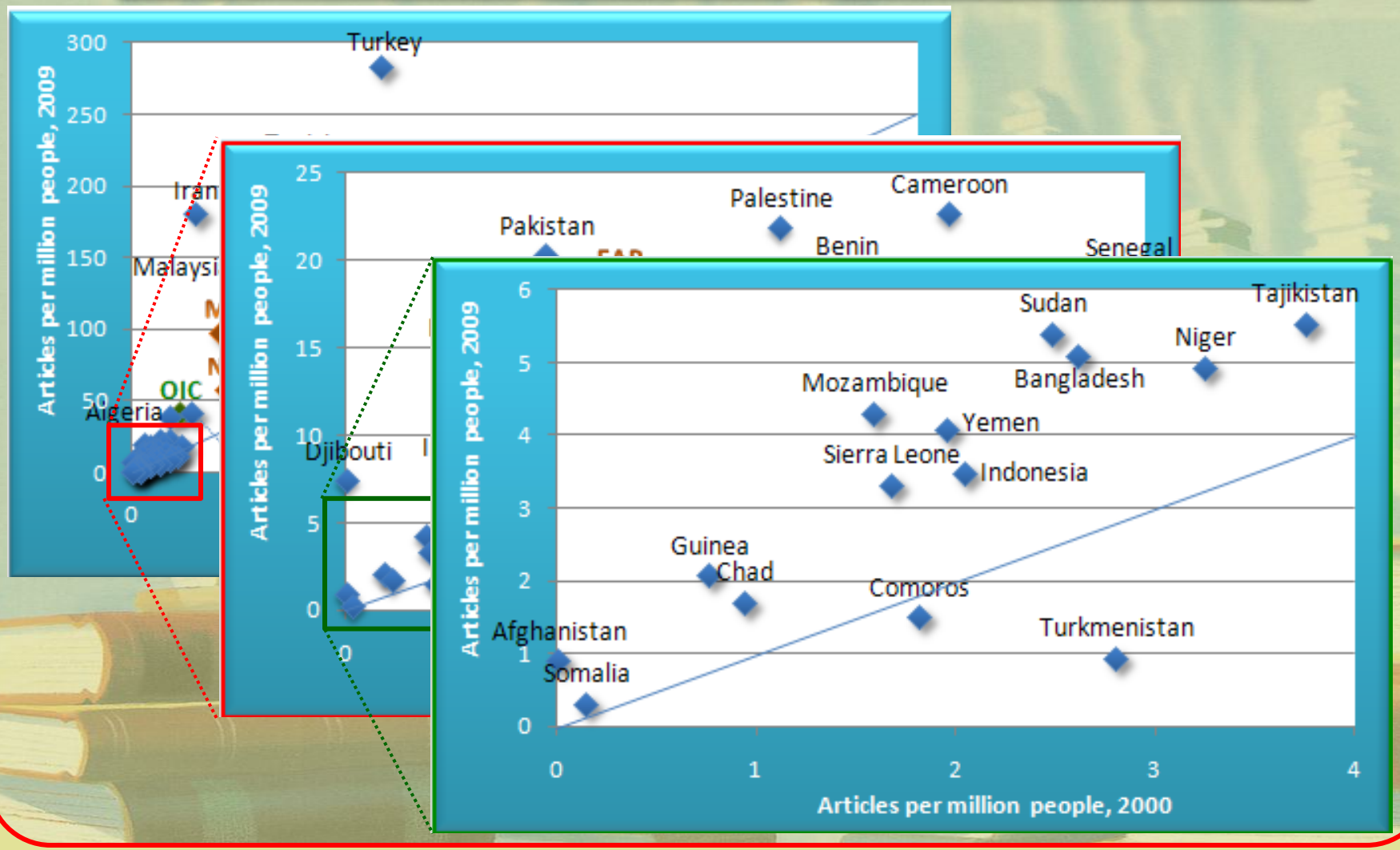


Turkey and Iran together produce more than half of published articles

Together with Egypt, Malaysia and Pakistan, these countries account for 71.2% of all published articles

Scientific Publications

Articles per million people



Scientific Publications

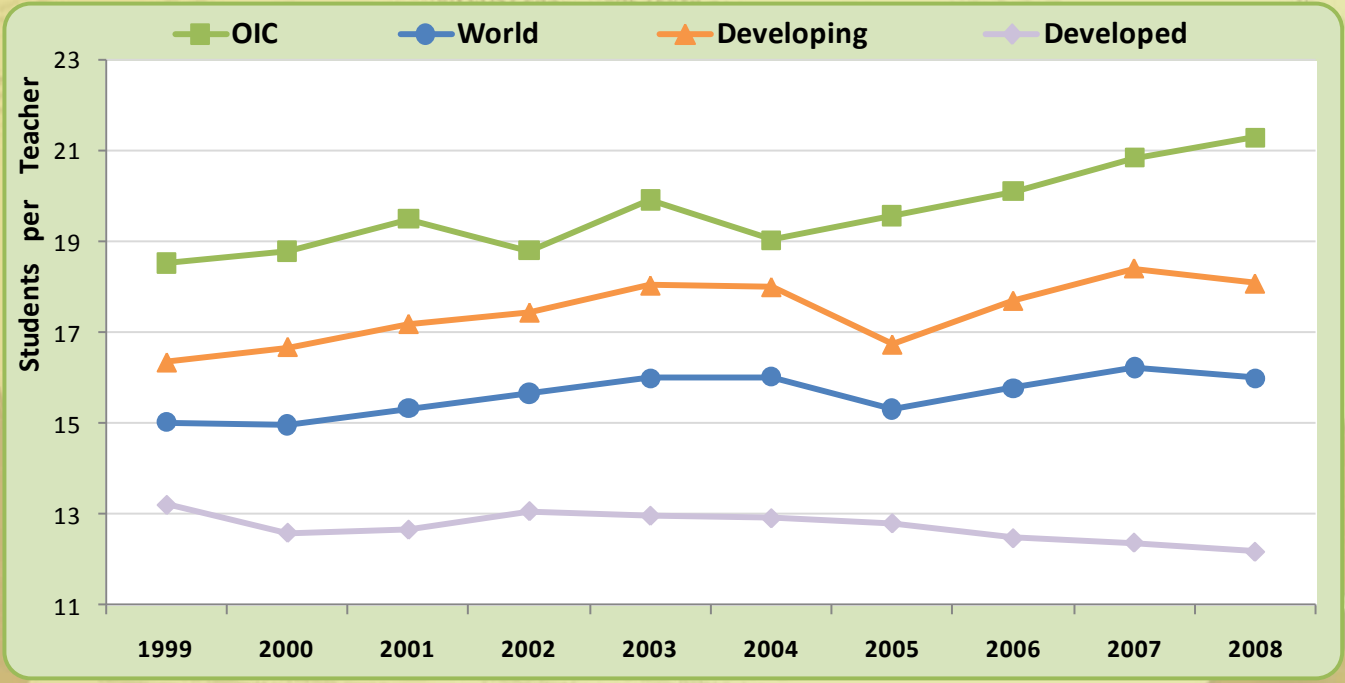
Articles per million people (in 2009)

Student Teacher Ratio at Tertiary Schools

Lower student-teacher ratios are generally considered to indicate higher quality education

There is a positive trend for student-instructor ratios at tertiary level schools globally, the only exception being developed countries

OIC countries perform poorly when compared to the rest of the world in terms of student teacher ratio at tertiary schools

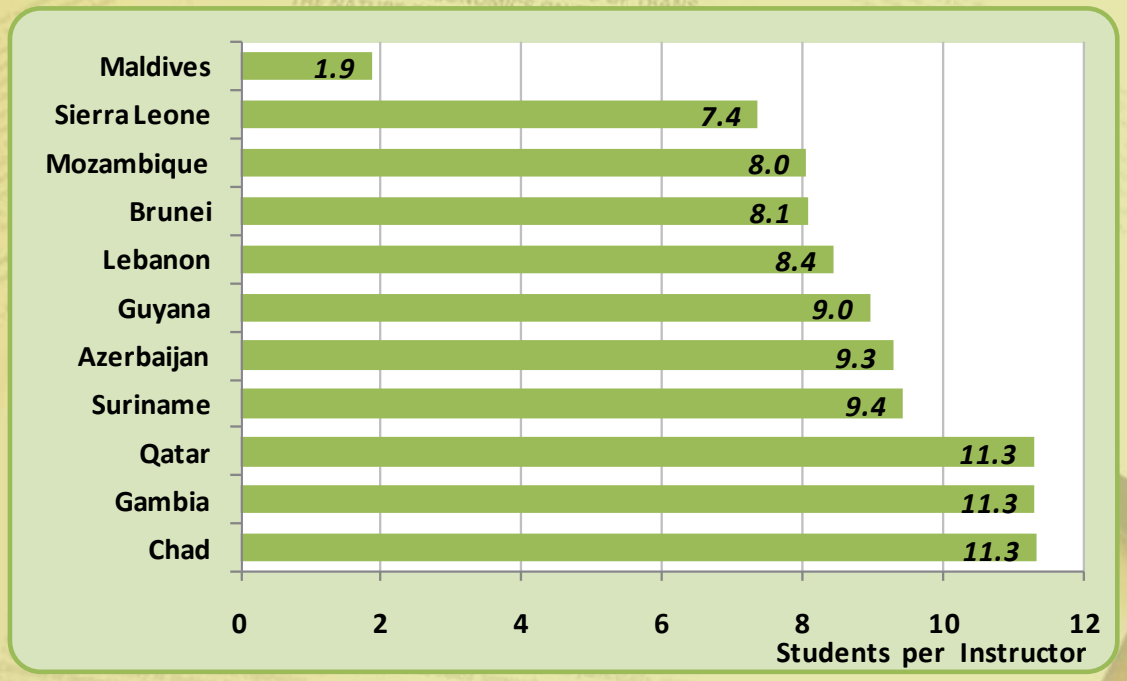


Student Teacher Ratio at Tertiary Schools

There is a great variation among OIC member countries in terms of student teacher ratio

There are only two tertiary level students per teacher in Maldives whereas the ratio is more than 60 in Mali and Togo

Top OIC Member Countries with Lowest Student – Teacher Ratios in Tertiary Schools (2008)

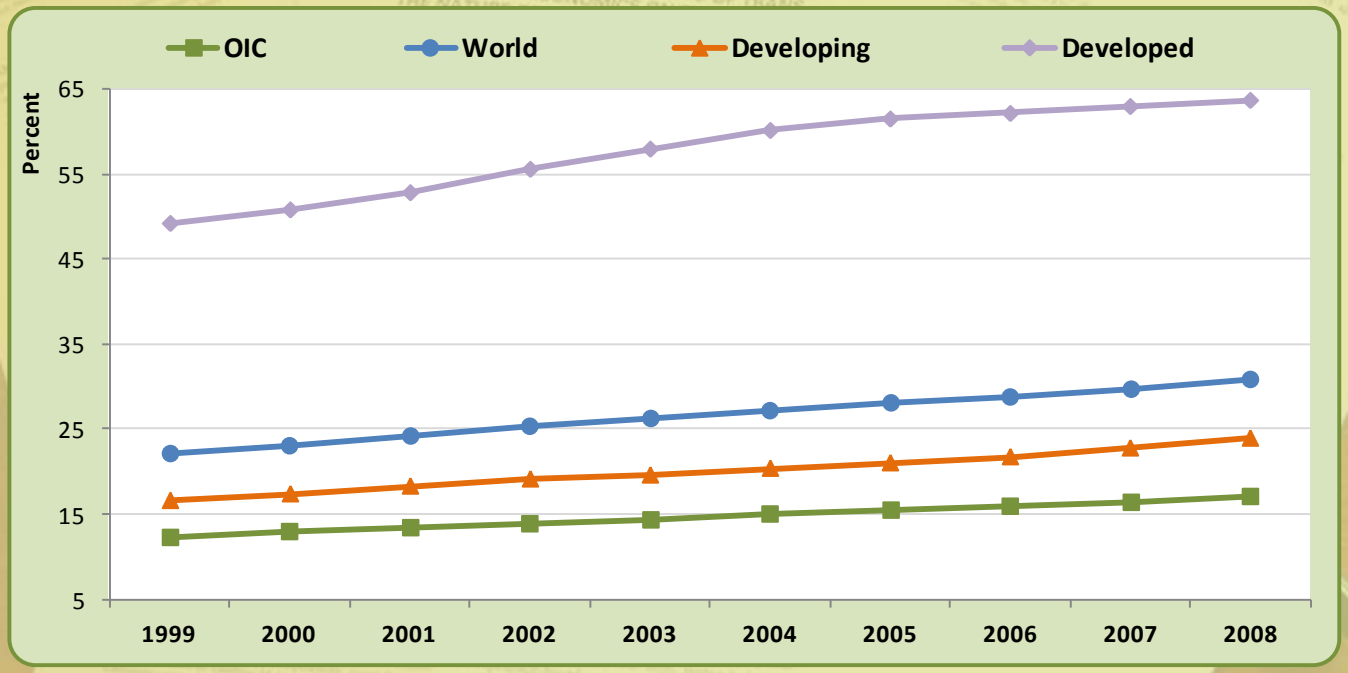


Enrolment Rate at Tertiary Schools

Higher enrolment rates are generally considered to indicate higher quality education

OIC member countries as a group experienced lower growth trend than those of developed, developing, and all countries

In 2008, OIC average (17%) was below that of developing countries (24%) and nearly half of the world (31%)

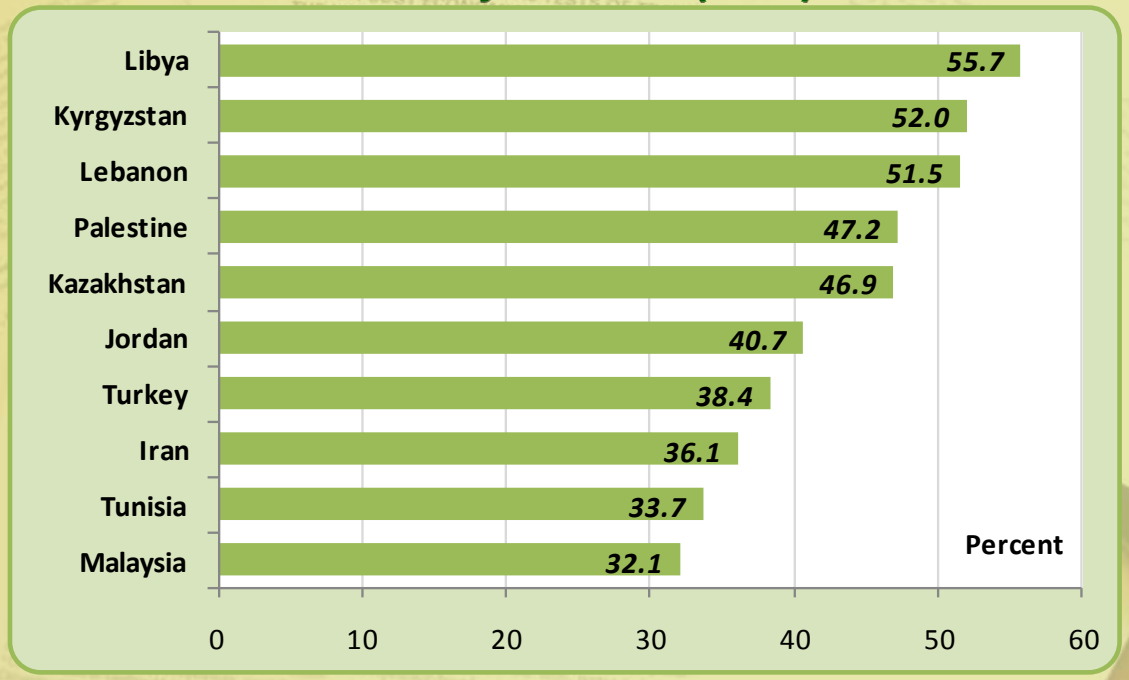


Enrolment Rate at Tertiary Schools

In 2008, ten OIC member countries achieved higher Enrolment Rate in tertiary schools than the World average of 31%

Libya, Kyrgyzstan, and Lebanon were top three as more than half of the tertiary school age students were enrolled in tertiary schools in these countries

Top 10 OIC Member Countries by Enrolment Rate in Tertiary Schools (2008)

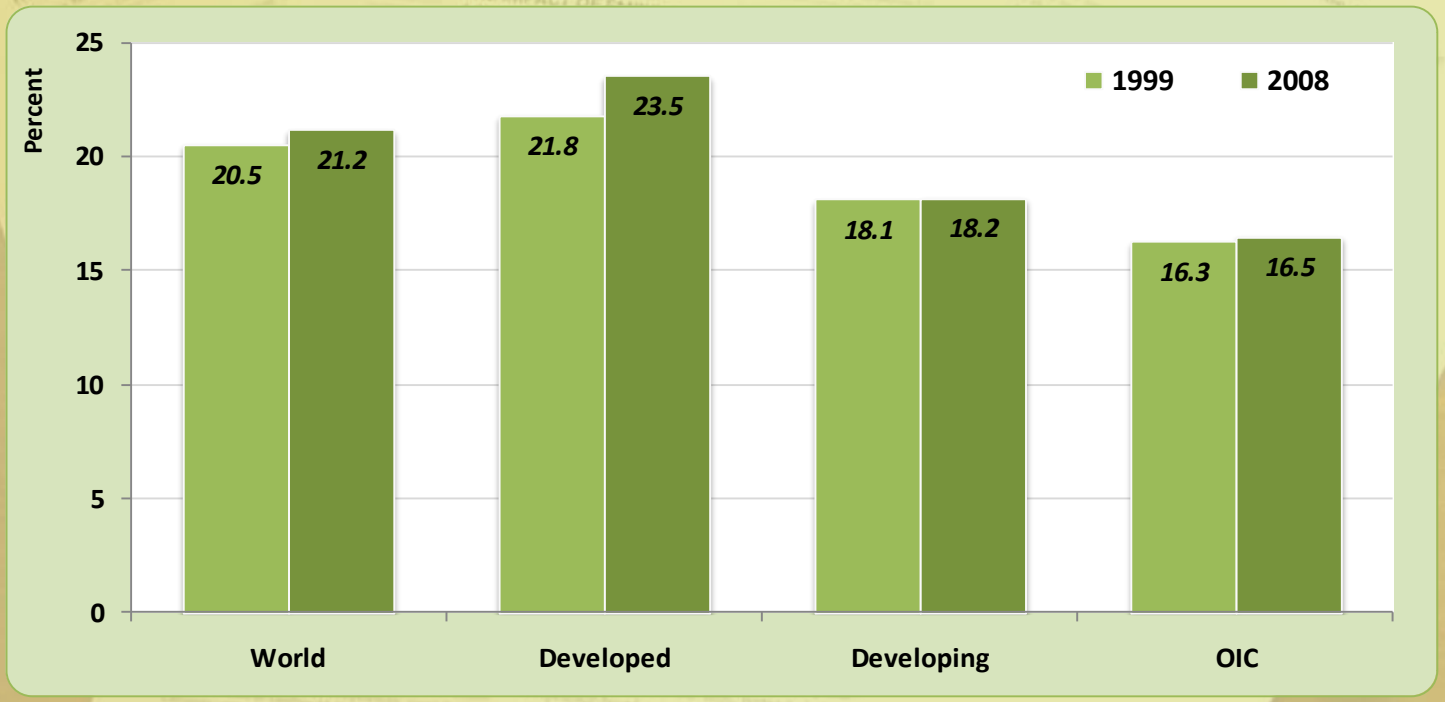


Public Expenditure for Education

The percentage of government expenditures on education per pupil in GDP per capita is a good measure of public investment on education

The percentage for OIC countries is lower than that for developing countries as well as that for the whole world

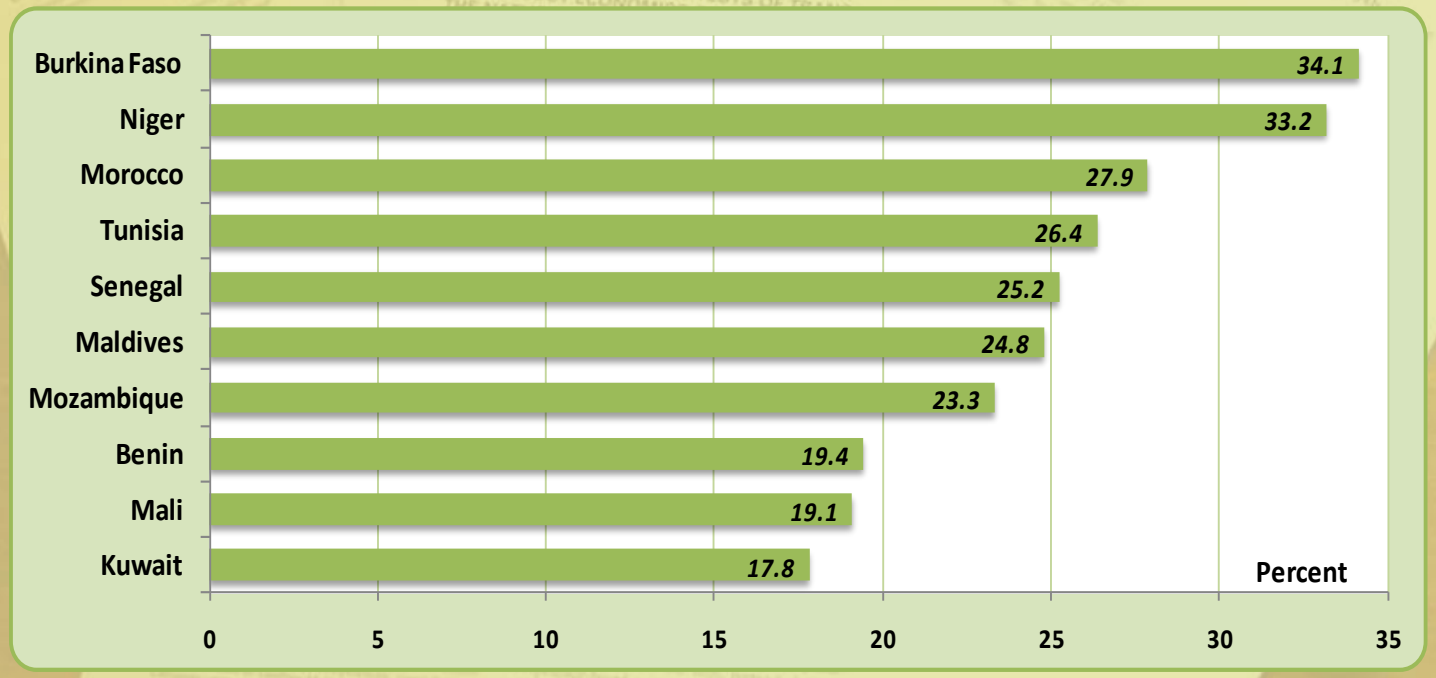
The percentage increased by 0.7 percentage point from 1999 to 2008 for the world whereas this increase was only 0.2 percentage point for OIC member countries



Public Expenditure for Education

In 2008, only seven out of 57 OIC countries reported a percentage of government expenditures on education per pupil in GDP per capita that is above the world average

Among the OIC member countries, Burkina Faso, Niger, and Morocco reported the highest percentages

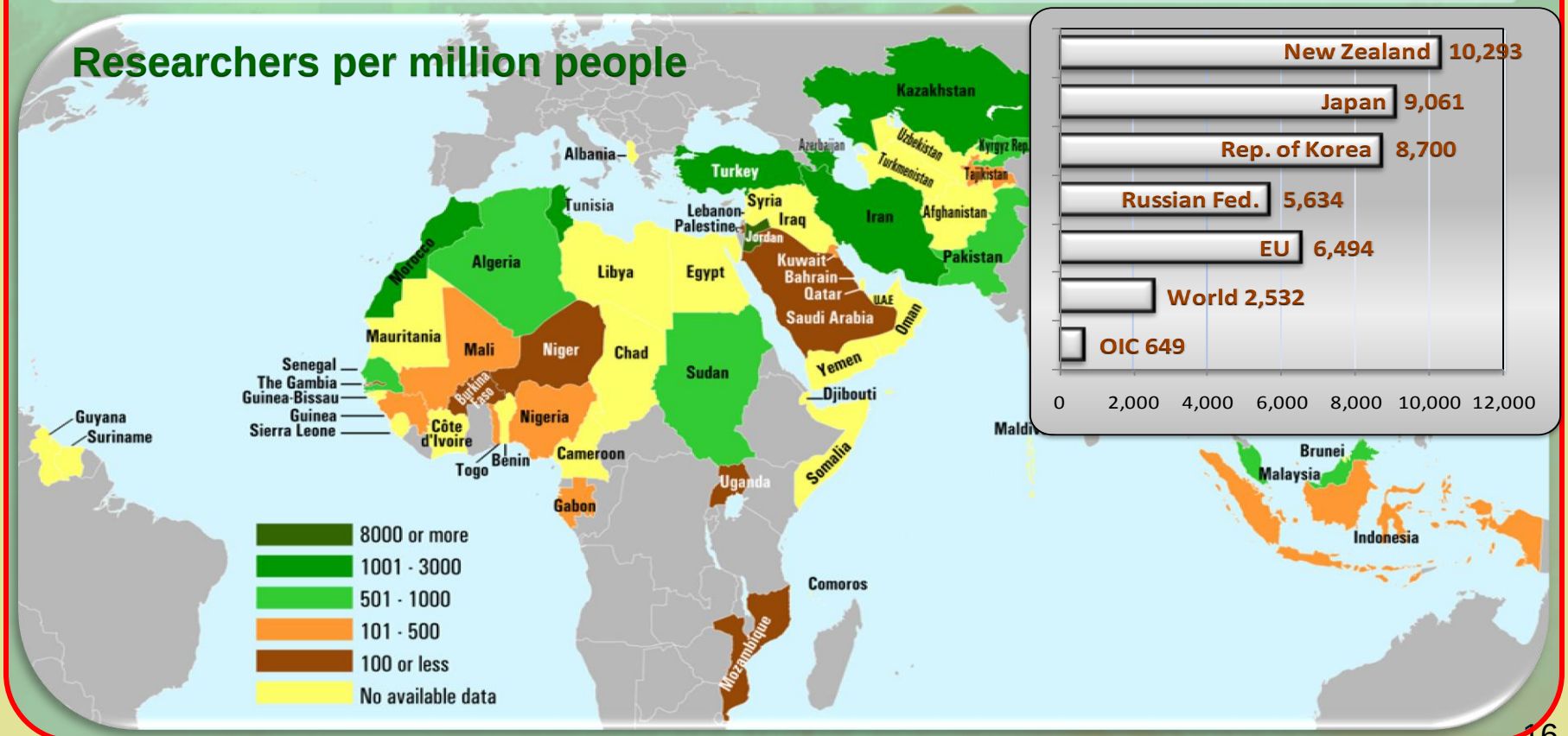


Other indicators of science and technology

Human Resources in R&D

The availability of highly qualified researchers is essential to foster innovation and promote scientific and technological development

OIC countries fall well behind world average in terms of researchers per million people: 649 vs. 2,532

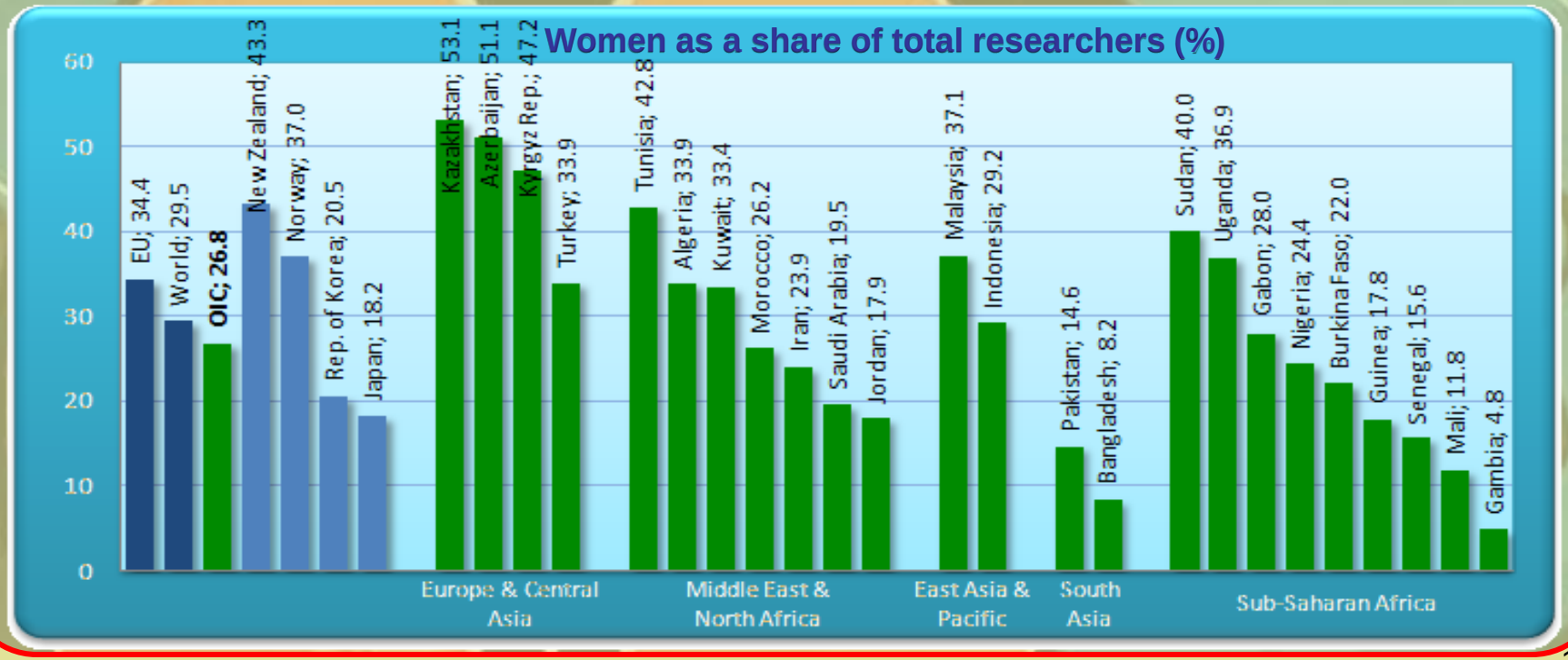


Women in Research Activities

Women have become more qualified and motivated to participate in labor force

Progress achieved in the field of R&D seems to be unsatisfactory neither globally nor at the OIC level

Women represent 26.8% of total researchers in OIC, slightly lower than world average of 29.5%



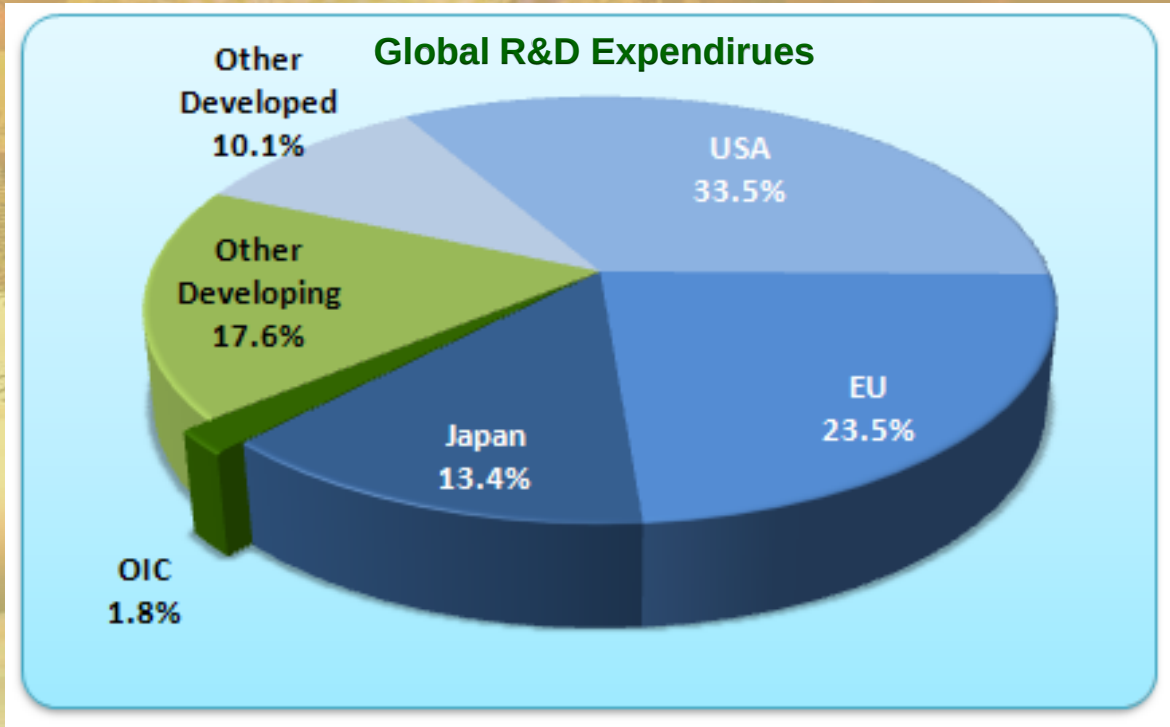
Expenditures on R&D

80% of global R&D expenditures is spent by developed countries

OIC countries' share of Gross Domestic Expenditures on R&D (GERD) is

1.8% in the world

9.5% among developing countries



R&D Intensity

R&D intensity (R&D Expenditures as percentage of GDP) is a widely used indicator

A higher R&D intensity indicates that relatively more resources are devoted to development of new products

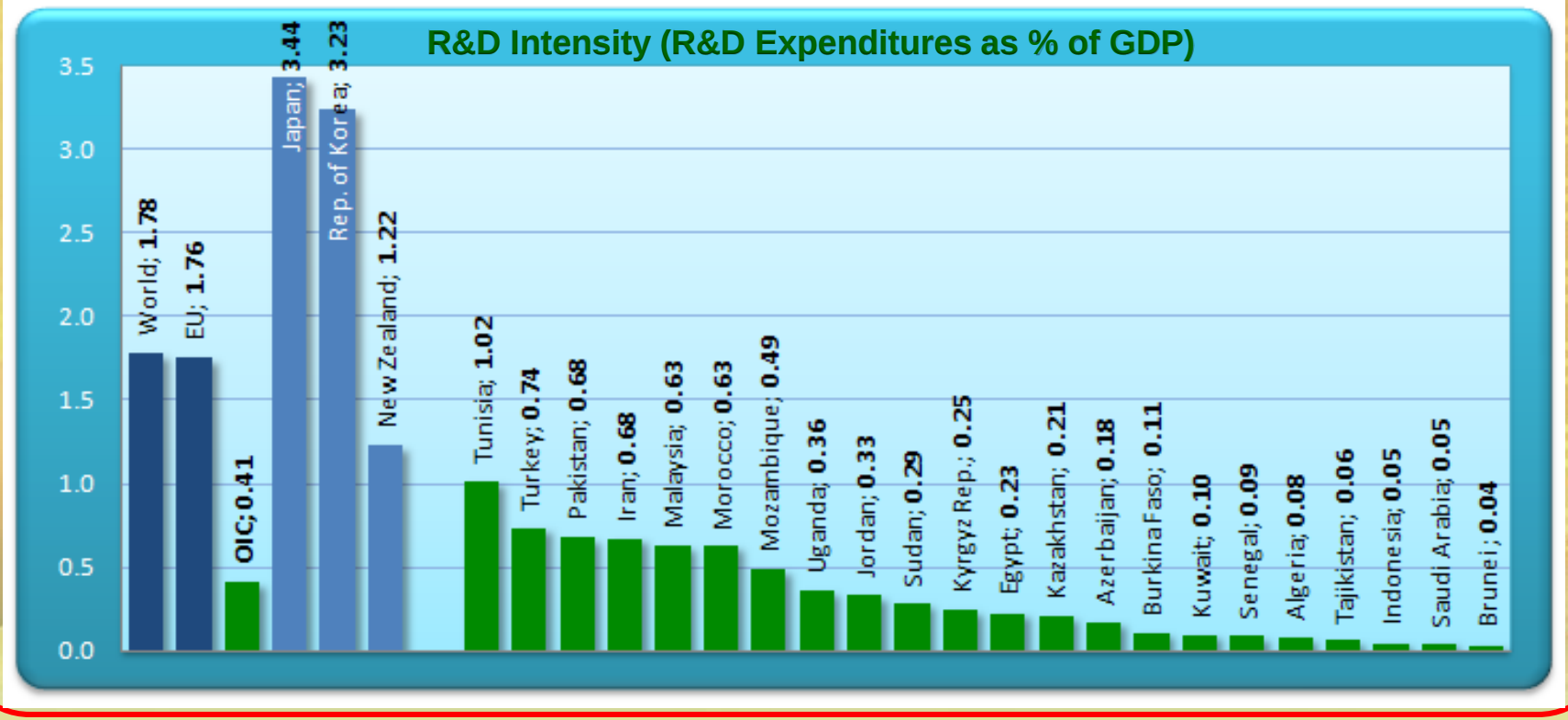
The OIC Ten-Year Programme of Action calls upon OIC countries to

"encourage research and development programmes, taking into account that the global percentage of this activity is 2% of the Gross Domestic Product (GDP), and request Member States to ensure that their individual contribution is not inferior to half of this percentage"

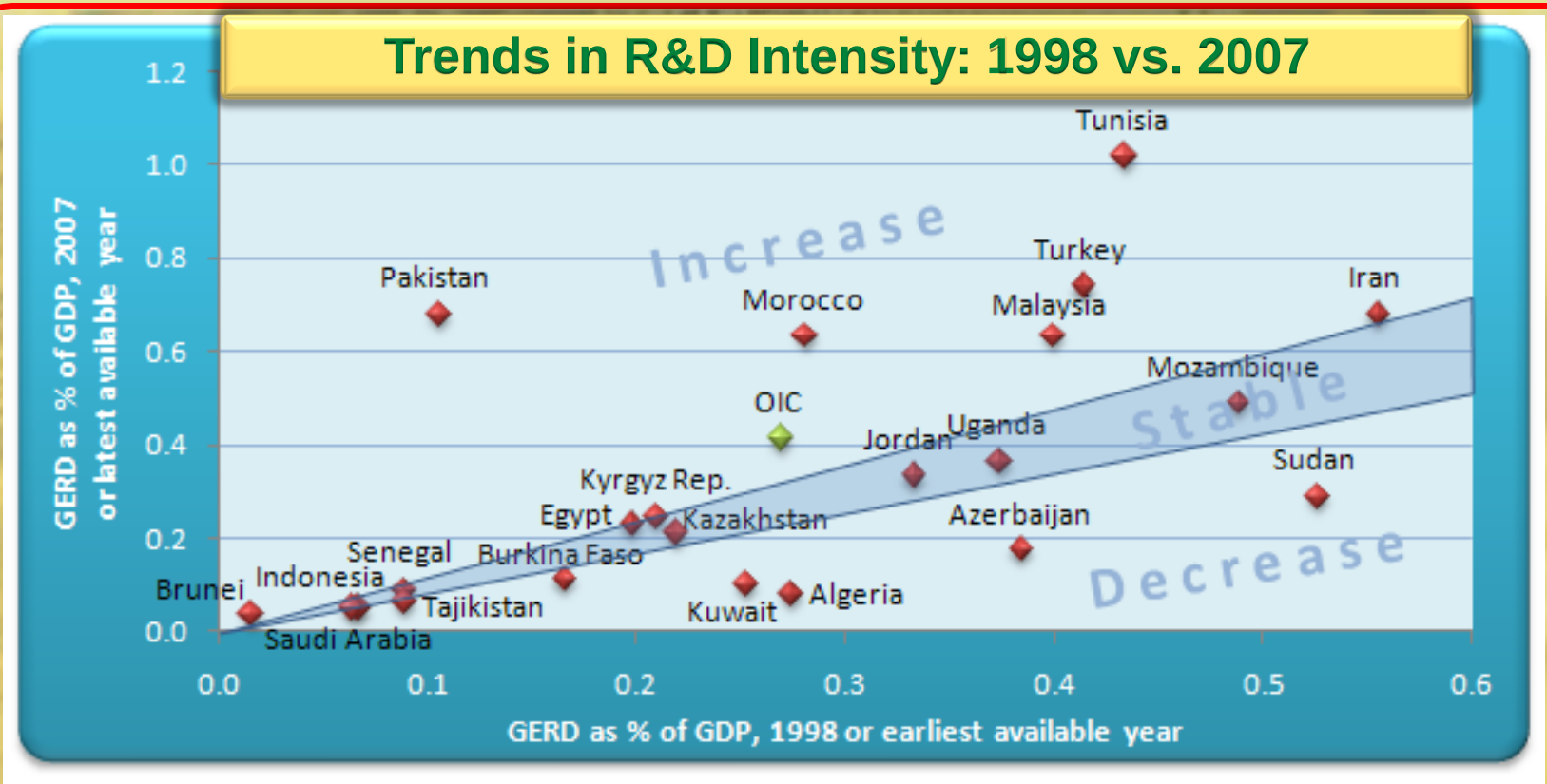
R&D Intensity

R&D intensity for OIC countries is quite lower than world average as well as targeted rate of 1%

Tunisia, the only country to have met the target so far, reports the highest level of R&D intensity, followed by Turkey and Pakistan



Evolution of R&D Expenditures

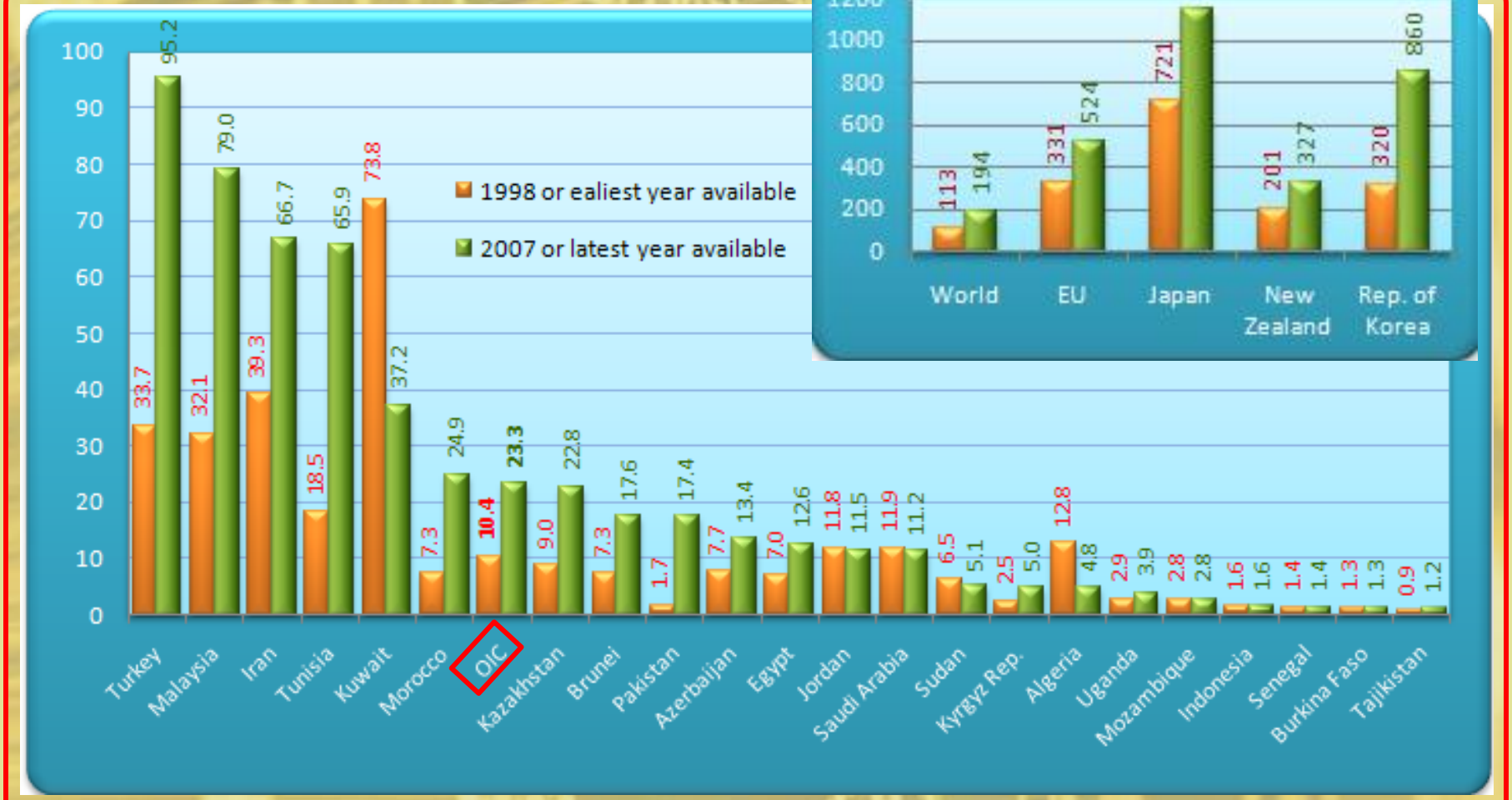


Tunisia, Turkey, Pakistan, Morocco, and Malaysia significantly increased their R&D intensity

Algeria, Azerbaijan, Sudan, and Kuwait reported a significant decrease

Average for OIC increased by 0.14 percentage point

R&D Expenditures per Capita (US $)



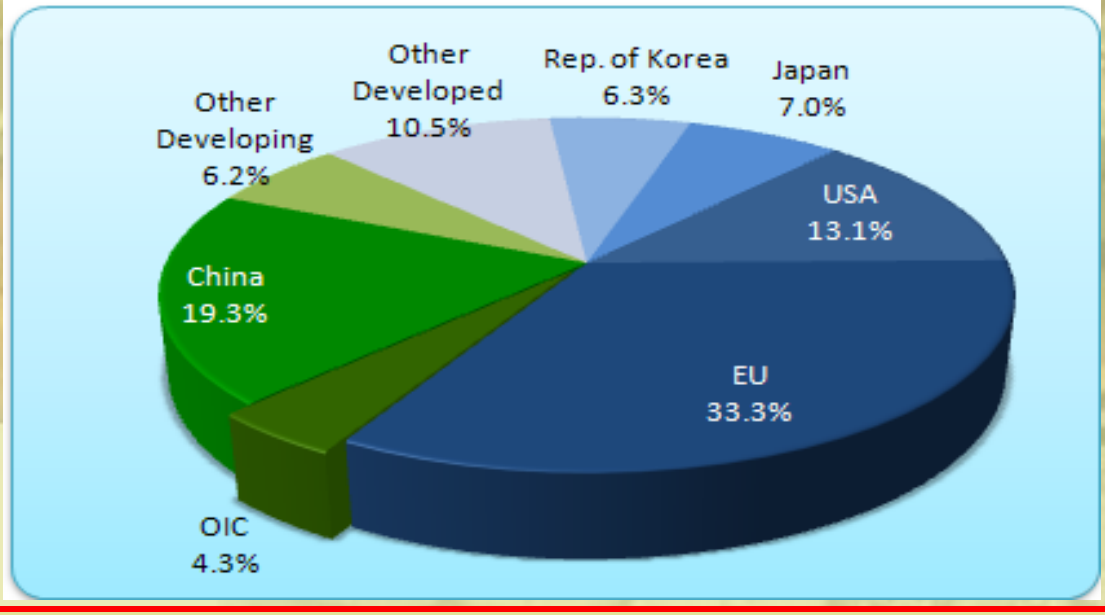
High Technology Exports

High tech exports include products with high R&D intensity

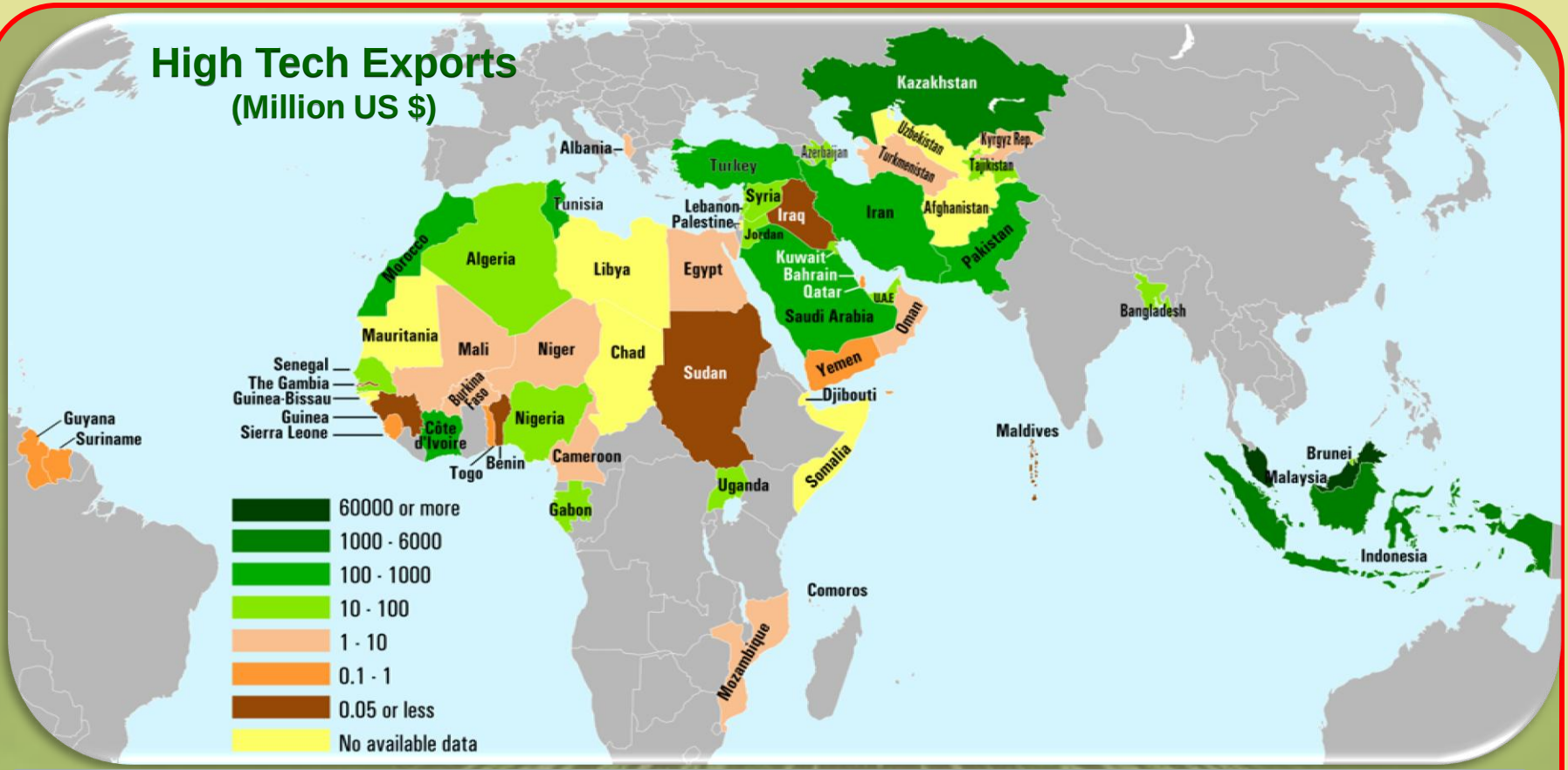
World high tech exports reached over $1.7 trillion in 2007

Around 70% originated from developed countries

48 of the 57 member countries accounted for only 4.3% of the world high technology exports



High Technology Exports in OIC Countries



Malaysia and Indonesia together represent 93.5% of total high tech exports of OIC

Malaysia, on its own, accounts for 86.5% of total high tech exports of OIC
It is the 9th largest exporter of high-tech products in the world with a share of 3.7%

Patent Applications

Total number of patent applications in the world in 2008 is about 1.85 million. less than 1% of which were filed in OIC countries

Non-residents account for about 60% of total applications in OIC countries

Majority of patent applications were filed in three countries: Iran, Malaysia, and Indonesia

Number of Patent Applications

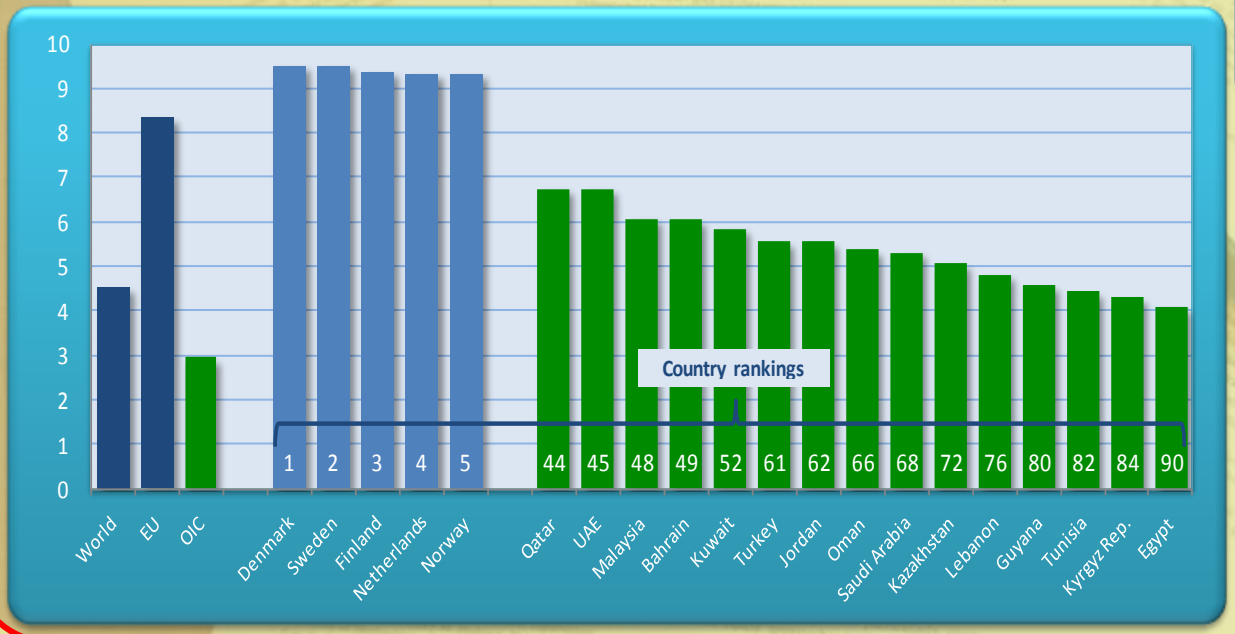
Country	Residents	Non Res.	Total	Year	Country	Residents	Non Res.	Total	Year
Iran	5,970	557	6,527	2006	Bangladesh	29	270	299	2007
Malaysia	818	4,485	5,303	2008	Syria	124	133	257	2006
Indonesia	282	4,324	4,606	2006	Azerbaijan	222	5	227	2008
Turkey	2,221	176	2,397	2008	Kazakhstan	11	162	173	2008
Egypt	516	1,589	2,105	2007	Kyrgyz Rep.	135	3	138	2008
Pakistan	170	1,375	1,545	2008	Brunei	0	75	75	2008
Morocco	177	834	1,011	2008	Mozambique	18	22	40	2007
Algeria	84	765	849	2007	Yemen	11	24	35	2007
Saudi Arabia	128	642	770	2007	Tajikistan	26	0	26	2006
Jordan	59	507	566	2007	Sudan	3	13	16	2007
Uzbekistan	262	186	448	2008	Uganda	6	1	7	2007
Tunisia	56	282	338	2005	Bahrain			3	2004
Lebanon			316	2006	Burkina Faso	1	0	1	2005

World Bank's Knowledge Economy Index

This index measures to what extent the environment is conducive for knowledge to be used effectively for economic development

Calculated as average of normalized scores of

- Education
- Innovation
- Information & Communication Technology
- Economic Incentive & Institutional Regime

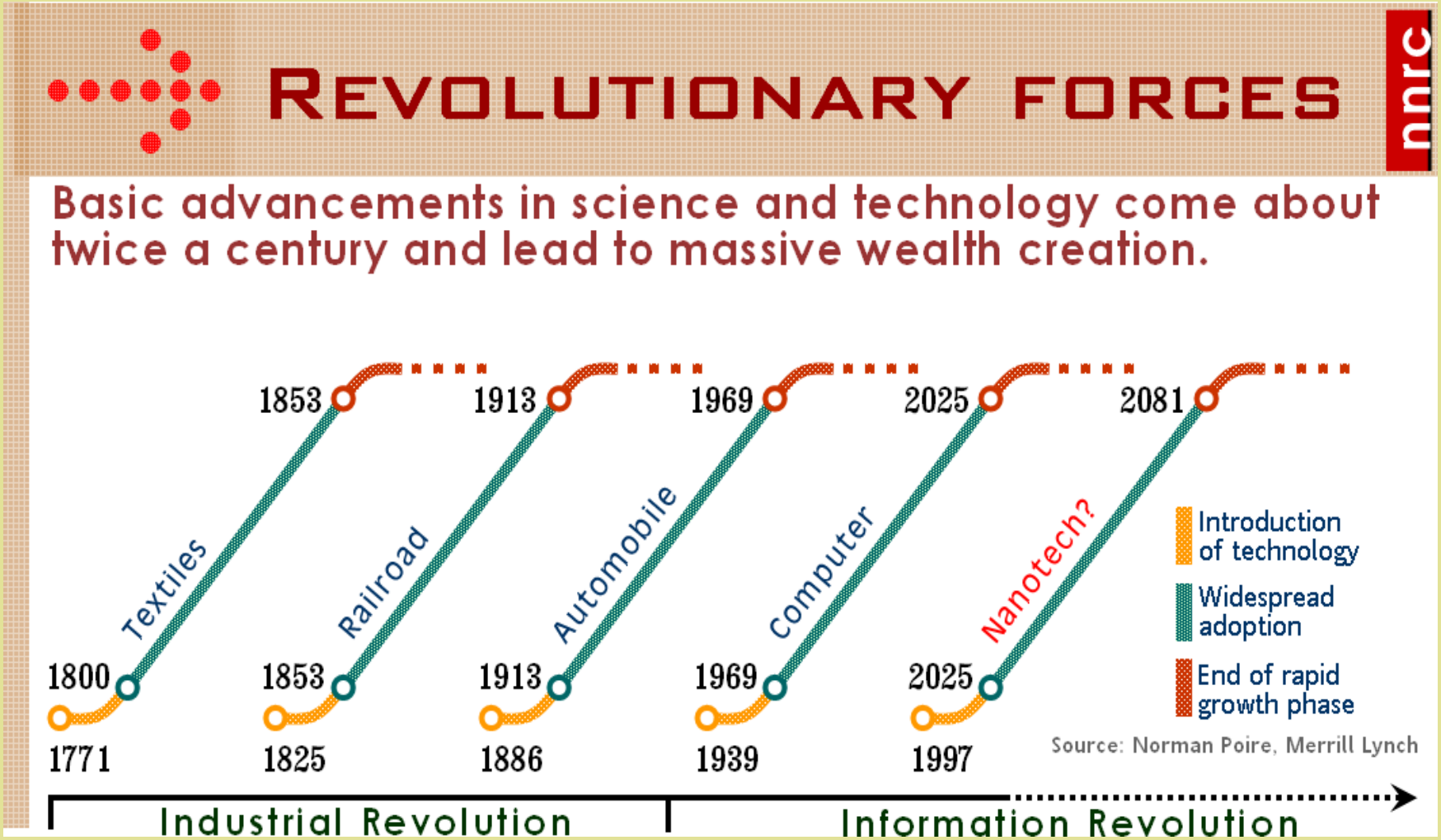


KEI is above world average in 12 out of 40 OIC countries for which index was calculated

Qatar and UAE are top two OIC countries standing only 44th and 45th in the world

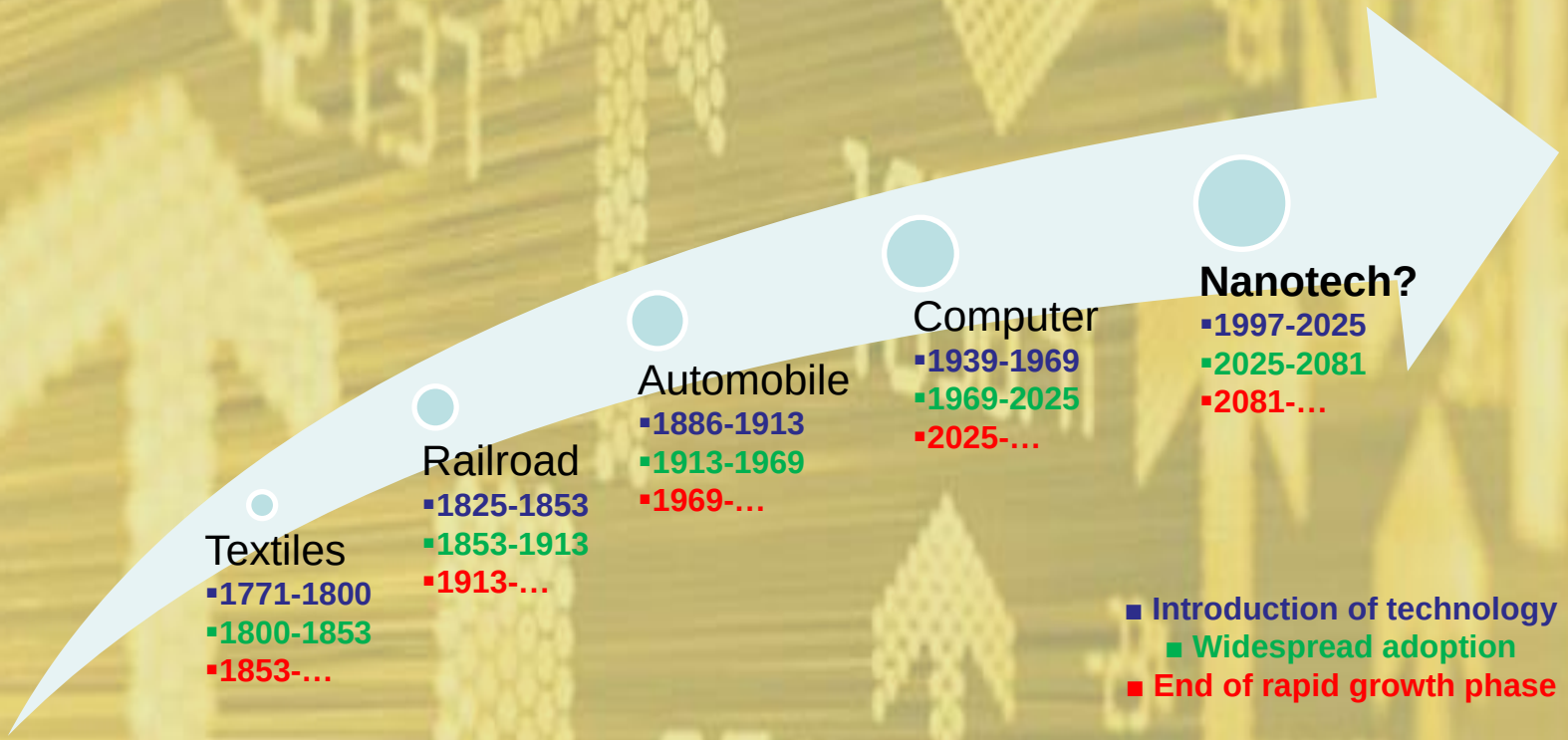
Half of the bottom 50 countries for which the KEI was calculated are OIC members

Nanotechnology !



Nanotechnology: Revolution is coming

Scientific advancements come about twice a century and lead to massive wealth creation



Nanotechnology: Economical Impact

Global nanoproducts market could reach $1 trillion by 2015, requiring about 2 million nanotech workers (Roco & Bainbridge; NSF, 2001)

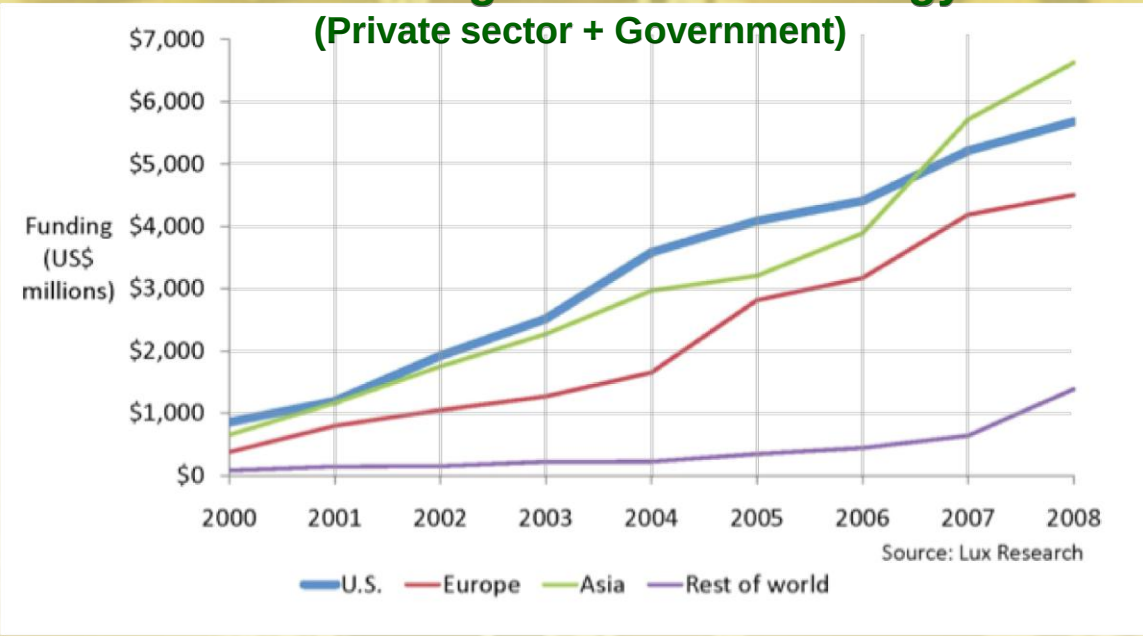
Russian government planned to invest $7 billion in 2007 through 2015

Israeli government planned to invest $230 million in 2005 through 2010

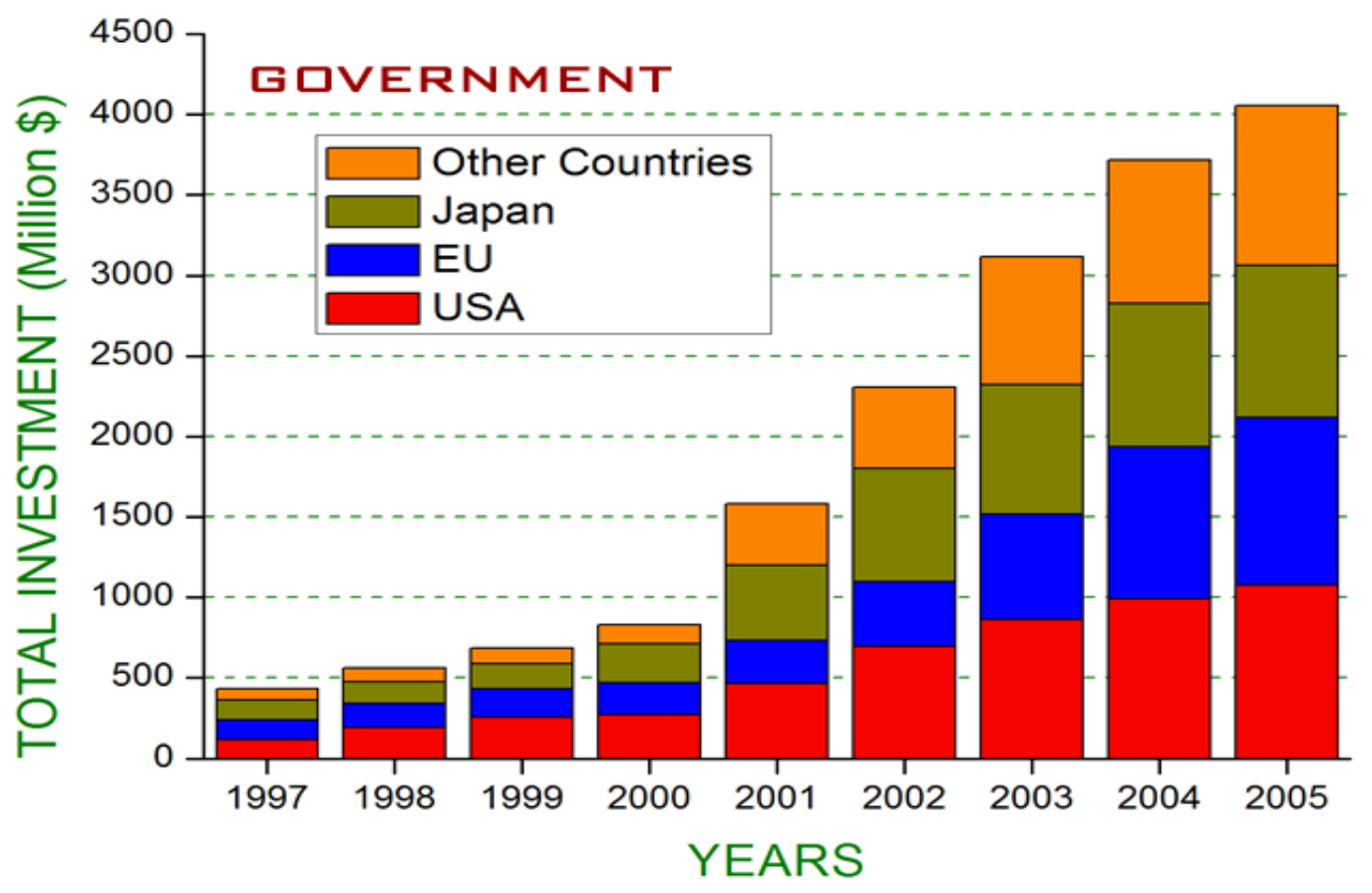
Total funding in US grew at 18% annually from 2003 to 2008, while funding in the rest of the world grew at 27%

Total funding for Nanotechnology

(Private sector + Government)

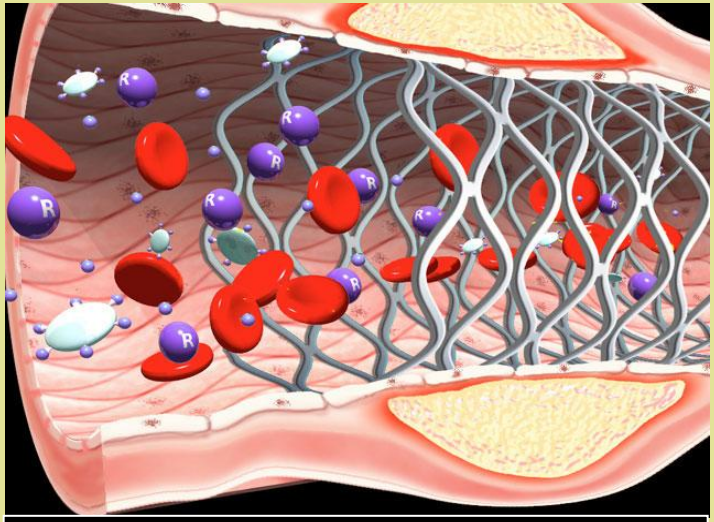


NANOTECHNOLOGY INVESTMENTS



- **Total Investment (world) in 2005: 6 Billion USD**
- **European Union: 4.8 Billion Euro for 7th Framework Projects**
- **South Africa: 170 million USD for next 3 years**
- **Israel: 230 million USD for next 5 years**
- **National Cancer Institute (USA): 143 million USD for next 5 years**

Nanotechnology: Economical Impact



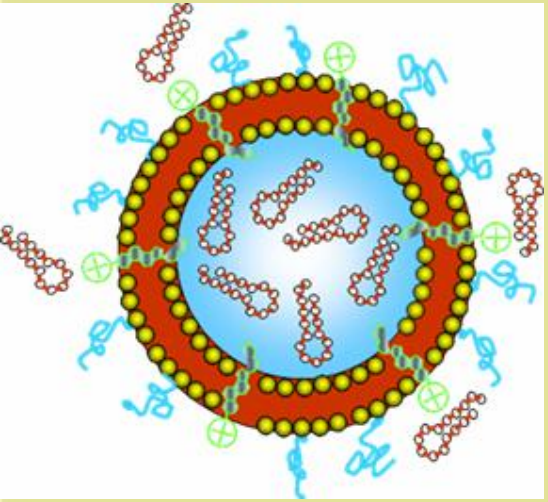
Heart Stent

- Production cost < 10$
- Selling Price: 10.000$
- Total income in 2004: 3 Billion $
- Total income in 2007 (expected): 11 Billion$
- Largest local income item around Boston area (USA)

Nanotechnology Will Have Very Big Impact On Economy

- Global market for nano products could reach $1 trillion by 2015.
- Many countries including USA, Germany, Israel, Korea support nanotechnology research as a critical field due to huge economical impacts.
- In Israel, 45 nanotechnology companies have already started to selling nano-products.
- China started a program to educate 1 million scientist and engineers in nanotechnology related fields. China expects to get very big economical impact from their nanotechnology investments.

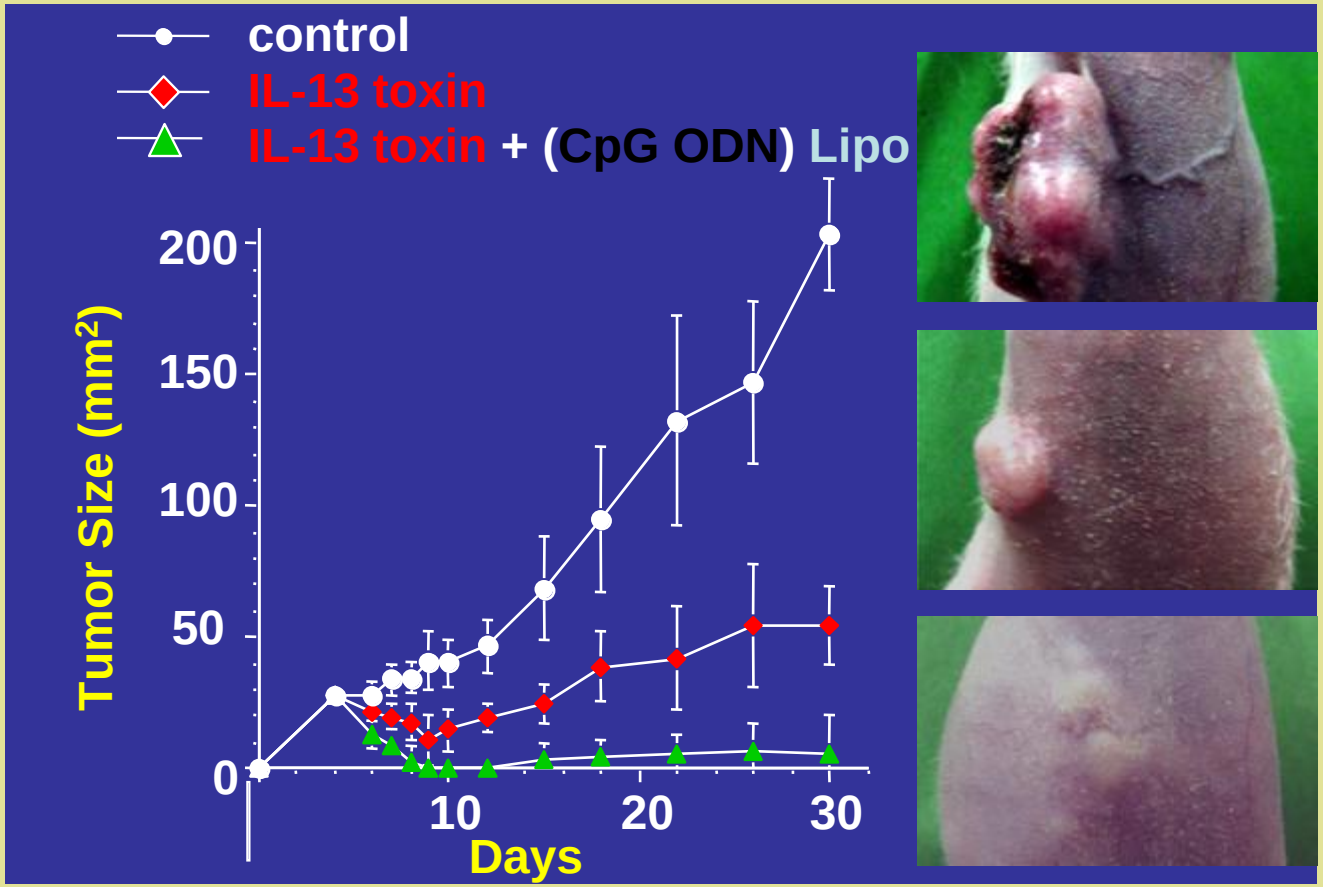
Nanobiotechnology: Treatment of Cancer



Nano capsul < 100nm

CpG ODN: DNA

Scientist observed that 91% of mice are free of tumor after this treatment.



Focus Areas of Government Investments in Nanotechnology

Country	Materials/ Manufact.	Devices (including Electronics & Optics)	Energy & Environment	Biotech/ Medical	Instrument Development	Education
Argentina	X					
Australia	X	X	X	X		
Austria						
Belgium	X	X		X		
Brazil	X	X		X		
Canada	X	X		X		
Czech Republic	X	X		X		
European Union*	X	X	X	X	X	X
France	X			X		
Germany	X	X		X	X	
India	X	X		X	X	X
Ireland	X	X	X	X		
Israel	X			X		
Italy	X	X		X	X	
Japan	X	X	X	X	X	
Korea	X	X				
Mexico	X					
Netherlands	X	X		X	X	
New Zealand	X					
Romania	X			X		
South Africa	X		X	X		
Switzerland	X	X		X	X	
Taiwan	X	X		X		
United Kingdom	X	X		X		
United States	X	X	X	X	X	X

Source: June 2004 International Dialogue on Responsible Research and Development of Nanotechnology, http://www.nanoandthepoor.org/international.php

Note *: While the EU as a whole is pursuing a broad program, individual EU countries (also shown here) have more targeted areas of research.

Policy recommendations

Higher education and academic research should be supported

- Allocate more resources for tertiary education (increase public expenditure)
- Hire more instructors for public tertiary schools (improve student teacher ratio)
- Ensure higher enrolment at tertiary education
- Encourage establishment of private colleges, universities, and research centres through funds and financial incentives
- Improve living standards for scientists and promote academic research through research grants and lesser teaching loads
- Encourage women to attend colleges/universities and remove obstacles that prevent them from higher education

R&D should be stimulated

Plan on reaching in foreseeable future the 1% target of R&D share in GDP

Facilitate network opportunities among OIC countries through projects similar to Framework Programmes of EU

Encourage research joint ventures among companies in OIC countries

Take advantage of R&D spillovers by

- Learning about new technologies developed in other countries
- Importing technological goods and services from high-tech trade partners

Encourage private sector to increase R&D expenditures through tax concessions or R&D subsidies

Patent development should be encouraged

Adopt measures to encourage patenting and technology licensing

Educate small and medium-sized enterprises about benefits and regulation of patent system

Establish an OIC level patent system

- To increase incentives for patent applications in the Islamic world
- To foster the establishment of relationships between the members in matters relating to R&D and patents
- To promote exchange of ideas, research, and studies on industrial property matters

Reduce waiting for examination of patents at patent offices

Infrastructure for internet should be improved

Communication sectors should be liberalized for better products and services

Promote internet usage through

- Tax reductions for internet services
- Transfer of internet subscrition charges from consumers to telecom sector and internet service providers

Teach English to students from early grades to improve internet literacy and effective use of internet

Encourage technology related majors in higher education to meet human resource needs in information and technology related sectors

Improve infrastructure for wireless network technologies for faster diffusion of knowledge

OIC countries should take part in Nanotech research and its commercialization

- Establish a world-class Nanotech Institute
  - To host graduate programs
  - To enhance collaborations among OIC member countries
  - To support venture capital
- Organize Nanotech conference and project fair
  - To develop Nanotech roadmap for OIC countries
  - To help researchers and investors meet
  - To create opportunity for networking and collaborations
- Initiate Nanotech collaborative research projects
- Support long-term scientist exchange between existing nanocenters

THANK YOU