COMPARISON of RESEARCH and DEVELOPMENT between TURKEY and EUROPEAN UNION

This report was prepared for Confederation of Turkish Employers Association

TISK

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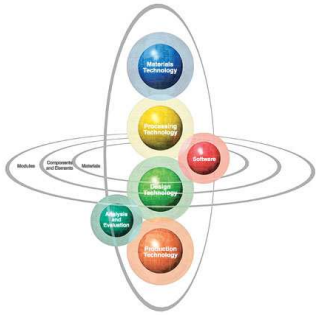


KNOWLEDGE CAPITAL

It is increasingly clear that Science and Technology (S&T); Research and Development (R&D), knowledge, innovation and Information Technology (IT) are keys to economic growth and productivity. They promote employment and prosperity and thereby help to create the basic conditions for stable and democratic social development.

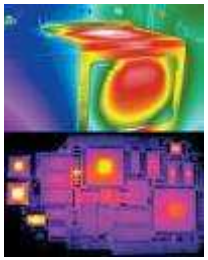
Long-term trends in the World

(GLOBAL SCIENCE, TECHNOLOGY and INDUSTRY OUTLOOK)

- **Since 2000, R&D expenditure relative to GDP (R&D intensity) has increased in Japan, and it has decreased slightly in the United States.**
- **In 2004 and 2005, Sweden, Finland, and Japan were the only three OECD countries in which the R&D-to-GDP ratio exceeded 3%, well above the OECD average of 2.3%. Since the mid-1990s, R&D expenditure (in real terms) has been growing the fastest in Iceland and Turkey, both with average annual growth rates above 10%.**
- **R&D expenditure for China has been growing even faster than GDP, resulting in a rapidly increasing R&D intensity, growing from 0.9% in 2000 to 1.4% in 2006.**
- **Some non-OECD countries (China, Russia, India, Brazil, S. Africa etc.) are becoming important R&D spenders.**
- **In 2005, the global shares of total R&D expenditure in the three main OECD regions were around 35% for the U.S., 24% for the EU-27 and 14% for Japan.**
- **The pace of business R&D growth has slowed; but, remains positive.**
- **The internationalization of R&D is spreading.**
- **Patents and scientific publications have surged.**
- **The demand for skilled human resources is accelerating.**
- **Recruiting and retaining the best talents are getting difficult.**

R&D is a Major Issue for Turkey

Turkey has been going through a period of economic transformation over the last 20 years characterized by:



- **Improved international trade relations,**
- **Increased exports,**
- **Created competitive economy,**
- **Integration with Europe,**
- **Establishing new state and private Universities with S&T Departments and Faculties,**
- **Allocating more funds for education and R&D,**
- **Encouraged R&D spending/investment,**
- **Improved R&D infrastructure,**
- **Fostered/stimulated Industry - University cooperation/colloboration,**
- **Established Technology Development Zones,**

Turkey believes that transition into an INFORMATION SOCIETY is achieved by investing in S&T, R&D and innovation.

GROSS DOMESTIC EXPENDITURES ON R&D (GERD) VOLUME, GERD PER CAPITA and GERD AS A PERCENTAGE OF GDP

	TURKEY	EU-27	OECD	USA	JAPAN	CHINA	EU-27 / TURKEY RATIO
2006 GERD VOLUME (Billion $) Current PPP	4.9*	242.8*	817.8*	343.7*	138.8*	86.8*	Total 49.55 Average 1.85
RANK in OECD	18/30*	3	1	2 Leading R&D investor	4	5	
2005 GERD PER CAPITA ($)	61	472		1093			7.78
All Sectors R&D INTENSITY (GERD as a % GDP)	0.58** 0.76*** 0.71*** 0.79*	1.84** 1.74*	2.25*	2.62* 2.68**	3.33* 3.18**	1.33 1.43*	
AVERAGE	0.71 (→2.0)	1.79 (→3.0)	2.25	2.65	3.26	1.38	2.52
RANK in OECD	30/35	17/37	11/37	7/35	3/35	20/35	
RANK in Eu-27	29/33						

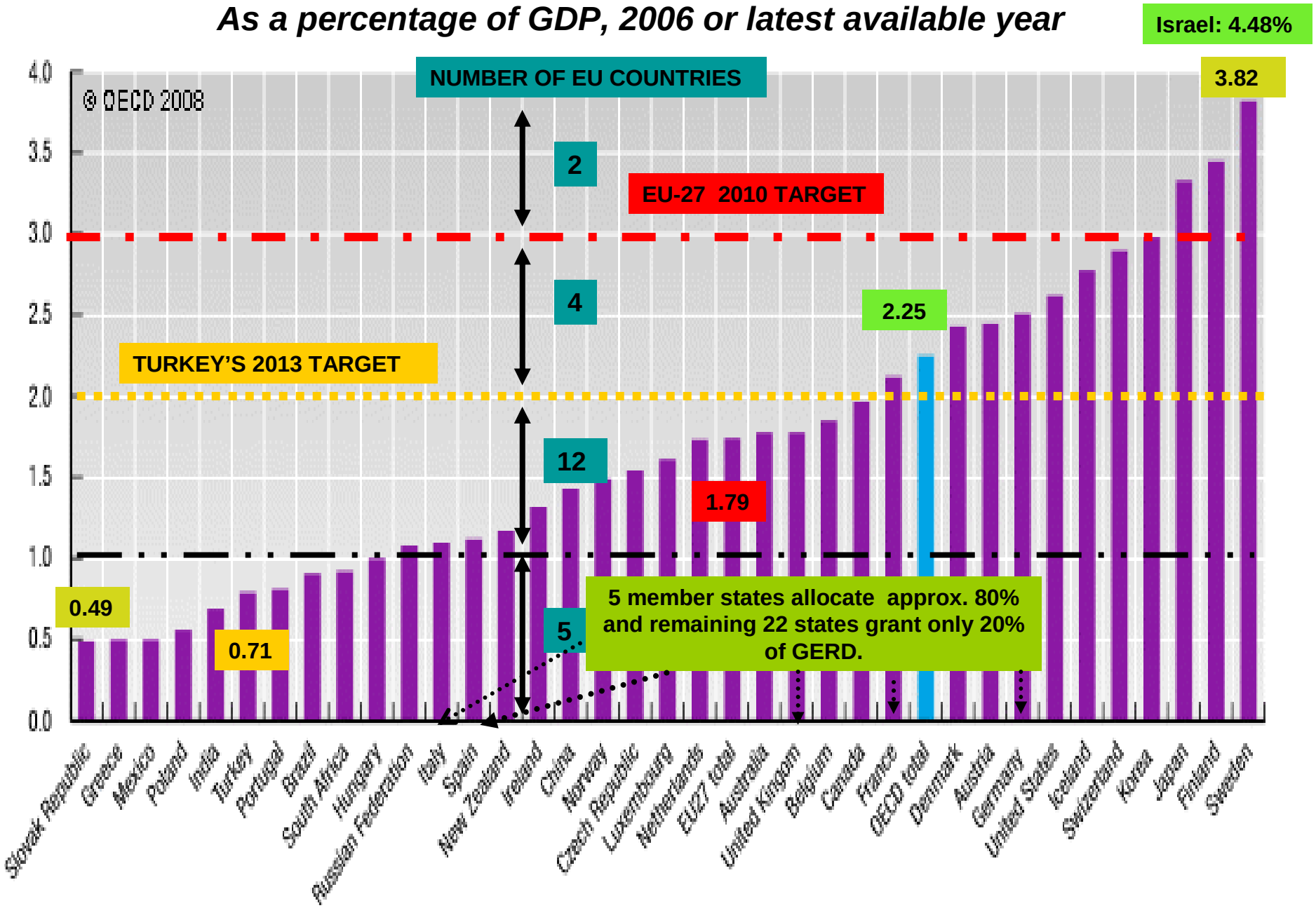
TURKEY WAS BETTER THAN BULGARIA, CYPRUS, POLAND, GREECE, SLOVAKIA and MEXICO in OECD

2010 LISBON STRATEGY and BARCELONA TARGET for EU-27: 3% Gross Domestic Expenditure on R&D as a percentage of GDP. TURKEYS 2013 TARGET: 2% GERD on R&D as a percentage of GDP.

* OECD ** Eurostat and *** TurkStat data

Gross domestic expenditure on R&D (GERD)

As a percentage of GDP, 2006 or latest available year



R&D INTENSITY BY SECTORS

	TURKEY	EU-27	OECD	USA	JAPAN	CHINA	EU-27 / TURKEY RATIO
2006 BES CONTRIBUTION TO R&D INTENSITY (%) AVERAGE RANK in OECD RANK in EU	0.28** 0.21* 0.25 29/33**	1.11** 1.18* 1.15 3		1.84* 2 	2.62* 1 	1.02* 4 	4.6
2006 GOV CONTRIBUTION TO R&D INTENSITY (%) RANK in OECD RANK in EU	0.07 31/32	0.24					3.43
2006 HES CONTRIBUTION TO R&D INTENSITY (%) RANK in OECD RANK in EU	0.30 18/30	0.40					1.33

R&D is MAINLY PERFORMED by HES in TURKEY and by BES IN EU-27 and OECD.

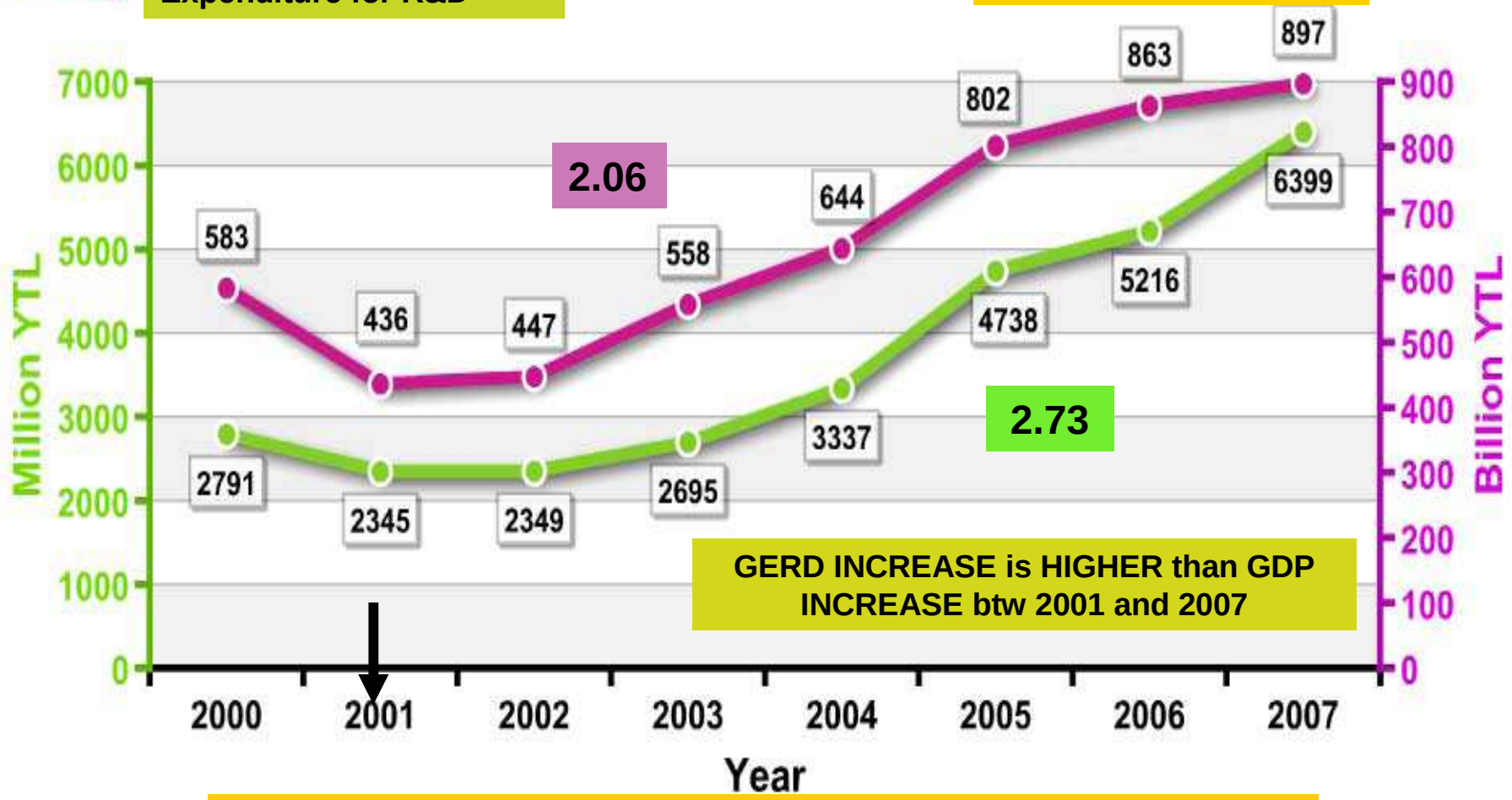
2010 LISBON STRATEGY and BARCELONA TARGET for EU-27: 2% BES contribution to R&D Intensity

- OECD ** Eurostat and *** TurkStat data
- BES: Business Enterprise Sector GOV: Government Sector HES: Higher Education Sector

GERD* vs GDP* (Turkey)

GERD: Gross Domestic Expenditure for R&D

GDP: Gross Domestic Product



"TURKEY is in the 25th place with respect to R&D spending in the world in 2008" (R&D Magazine)

Source: TurkStat (www.tübitak.gov.tr)

NOTE: For the 2006 and 2007 values by revised GDP, gross salaries are used for calculation of R&D labour cost in higher education sector

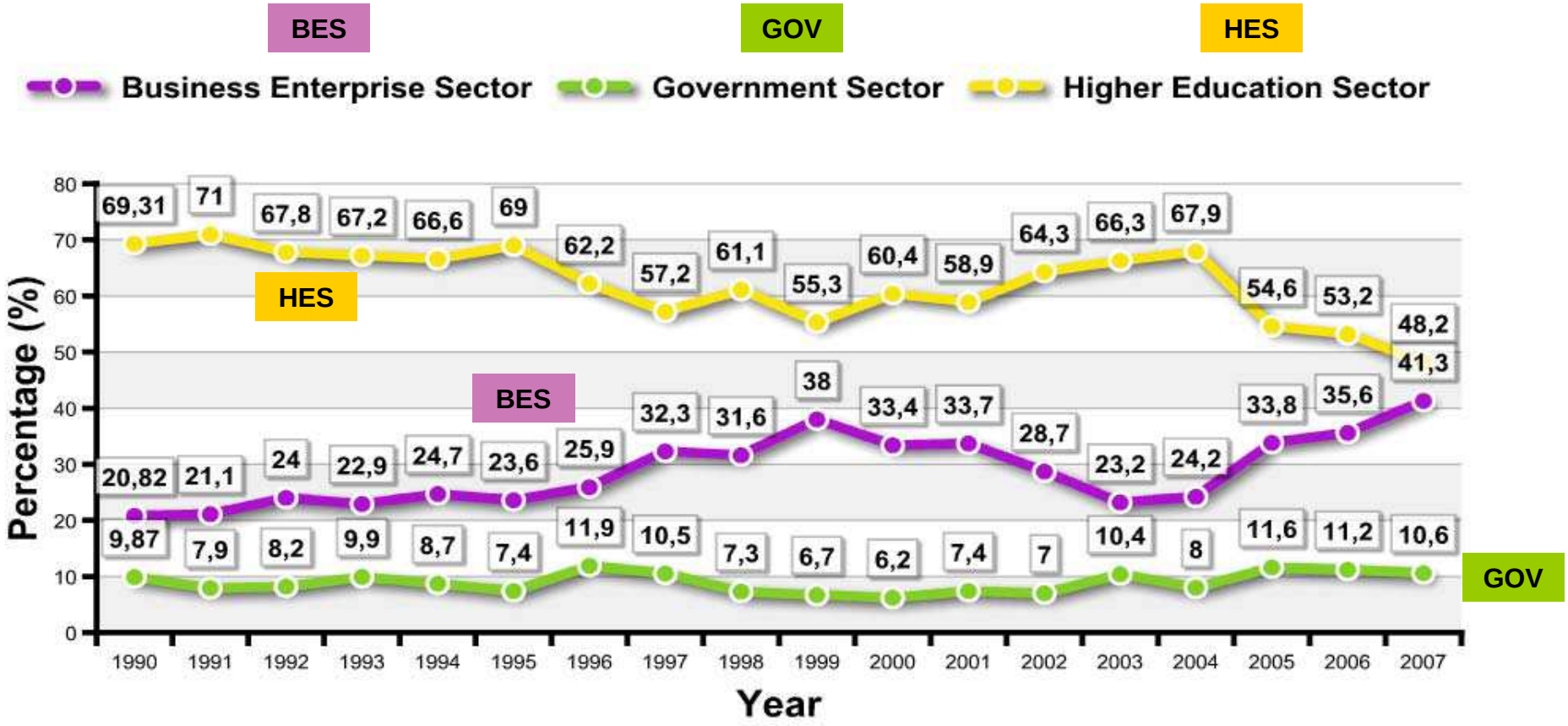
Percentage of GERD by Source of Funds (Turkey)

95.5% of GERD financed by Industry and Government

For the first time, Industry contribution passed Government contribution to the GERD in 2007

While Industry contribution to GERD is increasing, Government contribution is decreasing since 1990

Percentage of GERD by Performance Sectors (Turkey)



HES has highest contribution, BES has the second highest contribution and GOV has the lowest contribution in GERD.

While the contribution of HES is decreasing, the contribution of BES is increasing The contribution of GOV is low and remains stable since 1990

Source: TurkStat
NOTE: For the 2006 and 2007 values by revised GDP, gross salaries are used for calculation of R&D labour cost in higher education sector

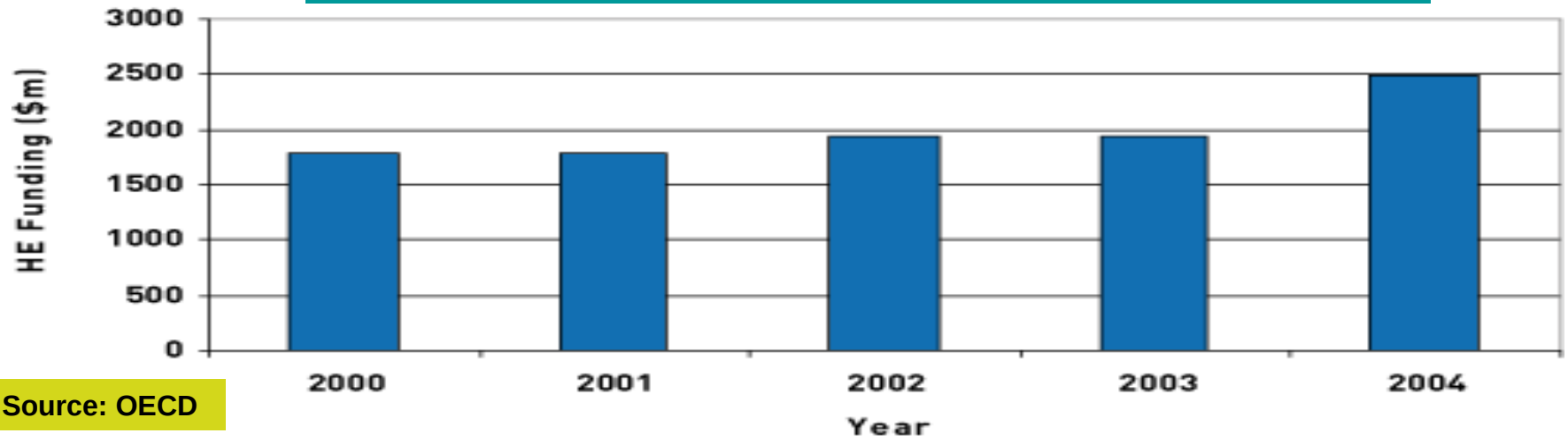
HIGHER EDUCATION FUNDING COMPARISON

Financial resources allocated for HE	
USA	2.7% GDP
EU	1.1%
Canada	2.5%
Korea	2.5%
Turkey	1.0%

Financial Resources allocated for HE (per student)	
OECD	> 10 000 USD
USA	> 20 000 USD
Turkey	3 500 USD

In 2005, OECD: 11512 $ and USA: 24370$

EXPENDITURE ON HIGHER EDUCATION IN TURKEY

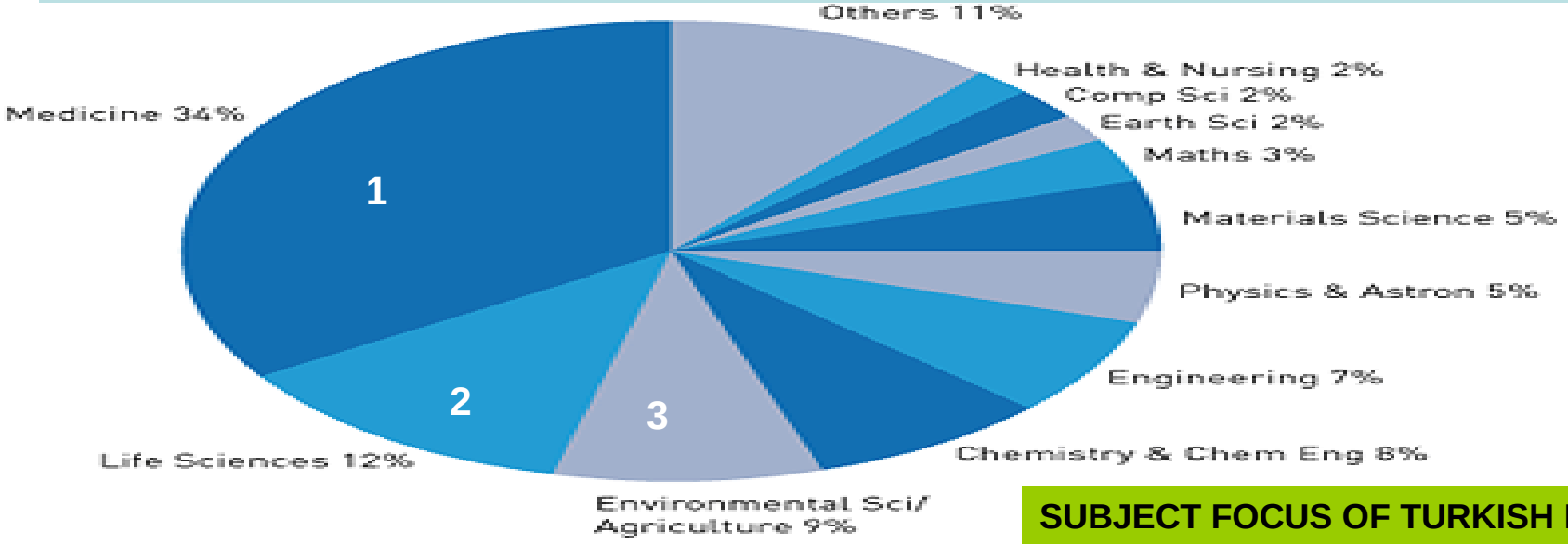


Source: OECD

COMPARISON OF SECTORAL R&D EXPENDITURE IN EU and TURKEY IN 2004

	Total Expenditure (EUR Million)	Agriculture	Engineering &Technology	Medical Sciences	Natural Sciences	Social Sciences	Humanities
EU-27 Rank	68366	6.0	20.6 2	18.7 3	34.9 1	11.0	8.8
TURKEY Rank	913	8.3	10.0 3	57.9 1	3.9	12.7 2	7.1
Turkey's Rank	14/32	18/29	26/27	1/28	29/29	16/28	16/28

R&D expenditure in EUR and by field of science as a percentage, GOV and HES for EU-27 and Turkey in 2004



SUBJECT FOCUS OF TURKISH RESEARCH ARTICLES IN 2006 (Source: Scopus)

MONITORING THE KNOWLEDGE WORKERS

HUMAN RESOURCES

- **The quantity of R&D personnel is one of the R&D input indicators along with R&D expenditure.**
- **R&D personnel includes all persons employed directly in R&D, as well as those providing direct services (i.e. R&D managers, administrations and critical staff).**
- **Head Count (HC) measures the total number of researchers who are mainly or partly employed on R&D.**
- **Full Time Equivalent (FTE) corresponds to one year's work for by one person (for example, a person who devotes 40% of his time to R&D is counted as 0.4 FTE).**

R&D HUMAN RESOURCES (HC) COMPARISON

2006	TURKEY	EU-27	OECD	USA	JAPAN	CHINA	TURKEY'S RANK
TOTAL RESEARCHERS							
ALL SECTOR	90118	1891068					6/30
BES	12%	38%					15/28
GOV	6%	12%					15/30
HES	79%	49%					7/28
SHARE IN % EMPLOYMENT							
ALL SECTOR	0.43	1.33					33/33
BES	0.09	0.57					33/33
GOV	0.05	0.16					29/33
HES	0.29	0.57					24/29
No. of FTE per 10000 EMPLOYMENT	18	60	74	97	110	16	29/34
SPENDING ON HUMAN RESOURCES	4.05	5.06					30/34
SHARE of WOMEN RESEARCHERS	36%	29%					14/33
S&T GRADS per 10000 POPULATION	62	133					30/34
DOCTORAL STUDENT in S&T	0.09	0.26					27/28

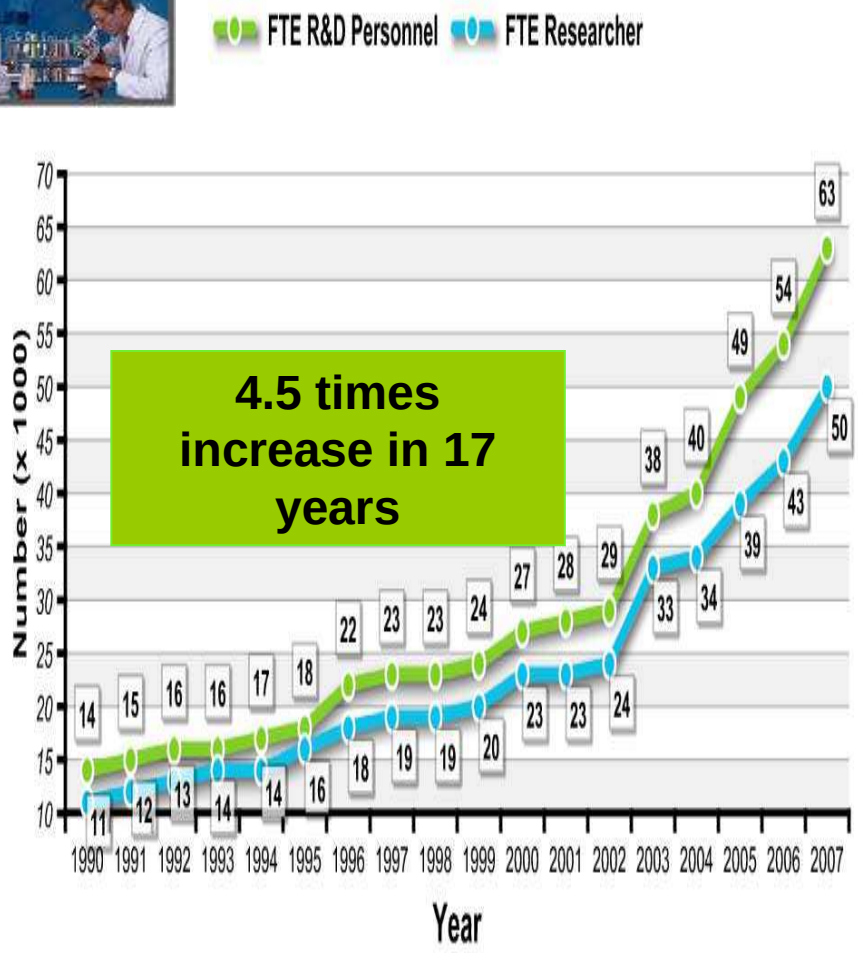
HES employs most of the researchers

BES and HES employ researchers

Turkey gives more opportunity to women in R&D

EU LISBON STRATEGY TARGET in 2010: to create 700000 new research jobs in EU.

R&D Human Resources per 10,000 Total Employment
R&D Human Resources – FTE* (Turkey)



MONITORING PRODUCTIVITY and COMPETITIVENESS

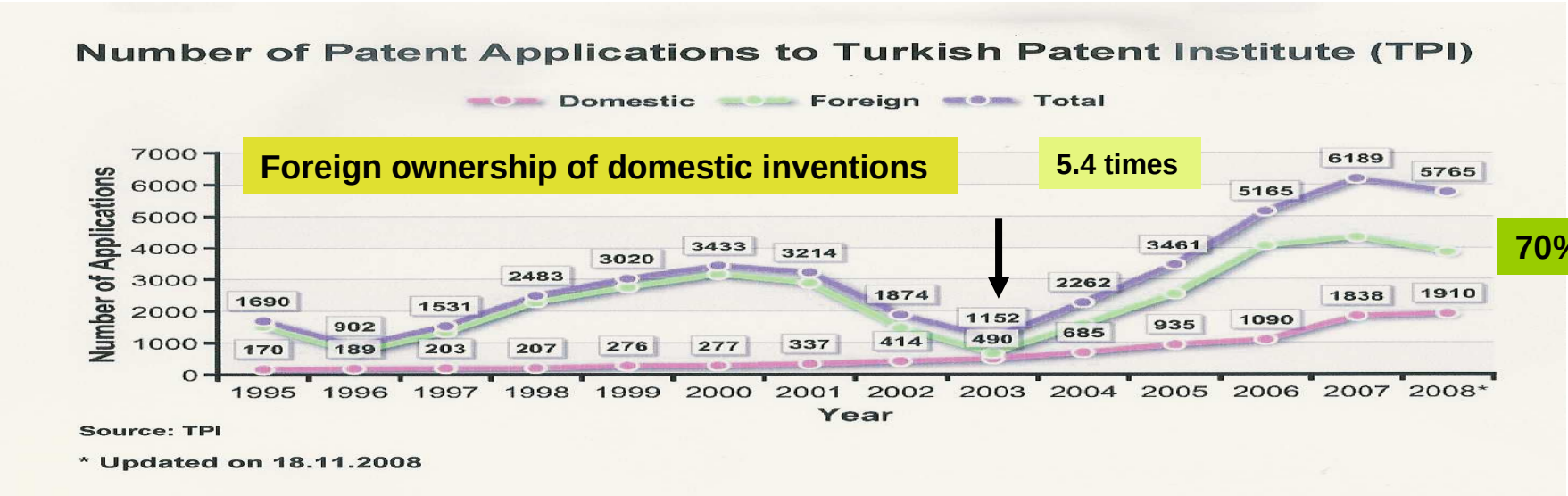
- **HIGH-TECH EXPORT**
- **PATENTS**
- **E-GOVERNMENT**
- **SCIENTIFIC PUBLICATIONS**

R&D Magazin Dergisi

Türkiye Ar-Ge'de 25. Sırada

MONITORING PRODUCTIVITY and COMPATITIVENESS

	TURKEY	EU-27	RANK in EU (EU-27/TURKEY)
High-Tech Export ratio, 2006	1.4%	17%	36/36 (12)
Employment in High-Tech Manufacturing, 2006	3.6%	6.6%	23/31 (1.8)
Total European patent applications	69	51874	24/37 (1.3%)
Patent applications to the EPO per million population	0.96	106	35/36(110)
Triadic patent families per million inhabitants, 2005	0.4	43.9 (OECD)	27/33
E-Government usage, 2005	6%	23%	21/22 (3.8)
E-Government online availability, 2007	55%	59%	16/28
No. of publication per million population, 2006	270	1025	
Rank in no. of Sci. Pub., 2007	19		
Rank in Sci. Pub. per million population, 2007	45		



TURKEY'S TOP 10 BES R&D LIST IN 2006 (in NTL)

R&D Intensity

No	Company	R&D Expense	Net Sales Income (NES)	R&DExpense/(NES)	
1	ARCELIK	76038000	6958683000	%1.09	
2	VESTEL	56885000	5231124000	%1.09	
3	BMC	56352678	972705273	%5.79	1
4	FORD	41831695	6521299345	%0.65	
5	SIEMENS	28000000	731269250	%3.83	3
6	ASELSAN	27968589	513117591	%5.45	2
7	BEKO	20555000	1805911000	%1.14	
8	SISECAM	16755406	2761131883	%0.61	
9	BSH Evaletleri	16053258	1723530222	%0.93	
10	TOFAS	9160000	3054160000	%0.30	
	Top 100 TOTAL	**512461557**		**Target: 2%**	

TURKEY AS A COUNTRY SPENT LESS MONEY FOR R&D THAN PFIZER and FORD MOTOR COMPANIES IN 2006

R&D/Revenue > 15% remarkable and usually gains a reputation for being a high-tech company.

Technology Development Zones (TDZ): Since 2002, Thirty one Technology Development Zones have been established for nurturing research and innovation in the country.

In these Zones	What are the Problems?
Advantages: • Income tax exemption • Corporate tax exemption • Opportunities for academic staff ***Facts:*** • 927 R&D companies • 8340 R&D personnel • 3800 projects • 25 foreign companies • Foreign investment: 450 M USD • Income generated by export: 124 M USD • Number of patents: 95	• Insufficient investment for o Infrastructure o Building developments o Human resources • Uncertainty in procedures Uncertainties in the relationships among different stakeholders • Uncertainty about the future of the TD Zones • Heavy bureaucracy at Ministerial level • Heavy bureaucracy at Municipality level

SMEs in TURKEY

Facts:

- They provide 76.7% of employment in Turkey
- SMEs with less than 250 employees represent almost 65% of employment in Turkish manufacturing sector.
- The SME share in total investments is 36%.
- SMEs are producing 26.5% of the value added
- The SME share in exports is 16.6%.
- The SMS share in investment is 6.5%.
- SMEs are concentrated in the traditional sectors (85% of all SMEs are concentrated in the sectors of food and beverages, textile, wood products, paper, fabricated metal products).
- There are totally 1720568 SMEs in Turkey.
- SMEs employ more than 6.3 million people.
- 32% of SMEs in the production sector have R&D potential
- Production sector SMEs employ more than 2M people.

SMEs in TURKEY

Problems:

- **Financial problems are very important.**
- **Poor systematic R&D investment.**
- **Insufficient infrastructure.**
- **Lack of high quality human resources.**
- **Lack of innovation culture.**
- **Lack of institutionalization.**
- **56% of SMEs do not make export.**
- **46% of SMEs suffer from financial sources.**
- **70% of SMEs do not use credits/loans from banks.**
- **63% of SMEs need financing.**
- **56% of SMEs do not have brand names, patents and useful models.**
- **60% of SME's do not use statistical quality control methods.**
- **72% of SMEs do not have performance management.**
- **76% of SMEs do not use CAD-CAM planning.**
- **SMEs commercial style is innovative; but, their technological base requires assistance and guidance.**
- **SMEs in Turkey are legally limited companies rather than incorporated company for stock exchange.**

TURKEY'S NATIONAL SCIENCE, TECHNOLOGY and INNOVATION STRATEGY FOR 2013

- R&D intensity will be 2% of GDP (requires more than USD 2034 billion GDP and USD 40 billion for R&D).
- In R&D expenditure, BES will have 55%, HES 26%, GOV 14% and others 5% share.
- BES should allocate USD 22.4 billion for R&D.
- Increase the number of FTE researcher to 123000.
- Increase the quality and ability of researchers.
- Increase the demand for R&D.

TÜBİTAK

SUGGESTIONS and CONCLUSIONS

- Increase Industrial Cooperation for Competitiveness
- Active Participation to the EU Framework Programmes
- Cooperation Between Research Institutes
- Establishing Technoparks and Research Centers
- Access to EU Joint Research Centers (JRC)
- Access to EU Universities and Web Sites as a Full Member Status
- Increase in the R&D Contribution of the Private Sector

- Coordination in Bodies Respon-sible for R&D
- Determination of R&D Priorities
- Improvements in Universities and in Higher Education System
- Improvements in R&D and Human Resources
- Increase the Role of Citizens and Organizations
- Solving Scientific/Technical Visa Problems of Turkish Researchers and Businessman

What are the URGENT NEEDS?

M O R E

- **Encouragement**
- **Coordination**
- **Autonomy in Higher Education (HE)**
- **R&D investment**
- **Investment for Higher Education**
- **Diversity in funding**
- **High quality creative human resources**
- **International cooperation**
- **Incentives for global competition**
- **Innovation culture across the country**
- **Fruits of R&D (The number of patents, publications etc.)**

L E S S

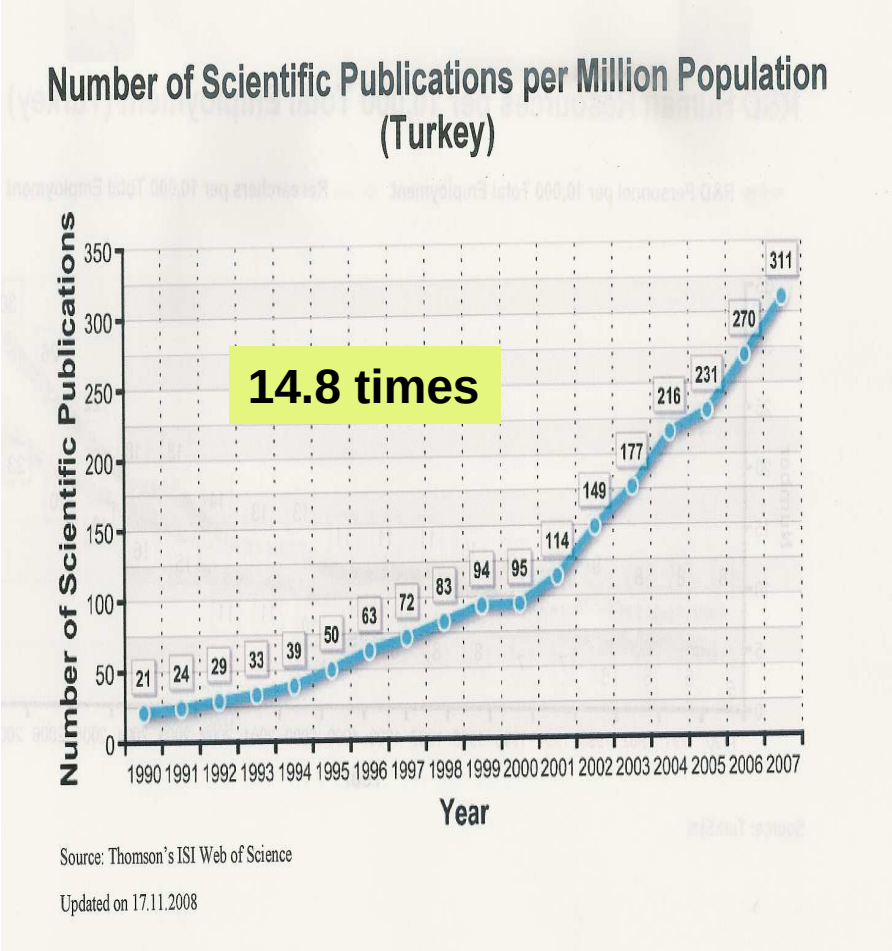
- **Bureaucracy**
- **Uncertainty**

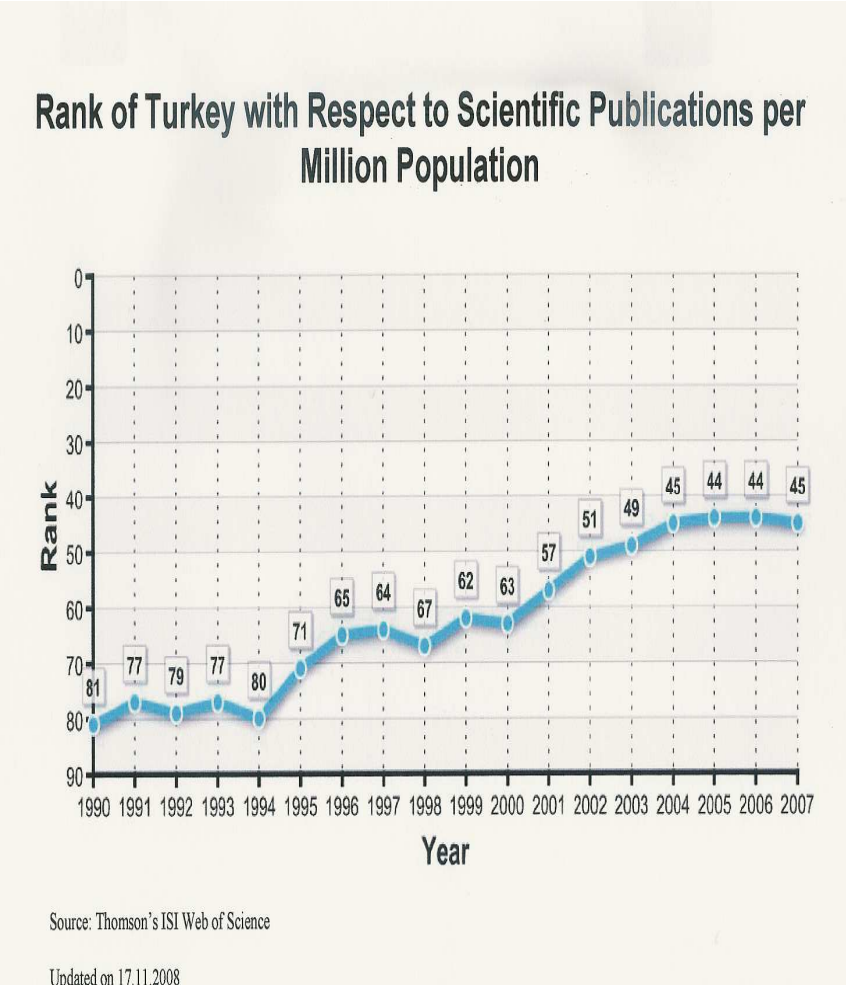
THANK YOU FOR YOUR ATTENTION

Prof. Dr. Muammer KAYA
Eskişehir-Osmangazi Üniversitesi-TEKAM Director

This report was prepared on be half of
Confederation of Turkish Employers Association
C T E A / T İ S K

NUMBER of SCIENTIFIC PUBLICATIONS per MILLION POPULATION and TURKEY'S RANK in the WORLD

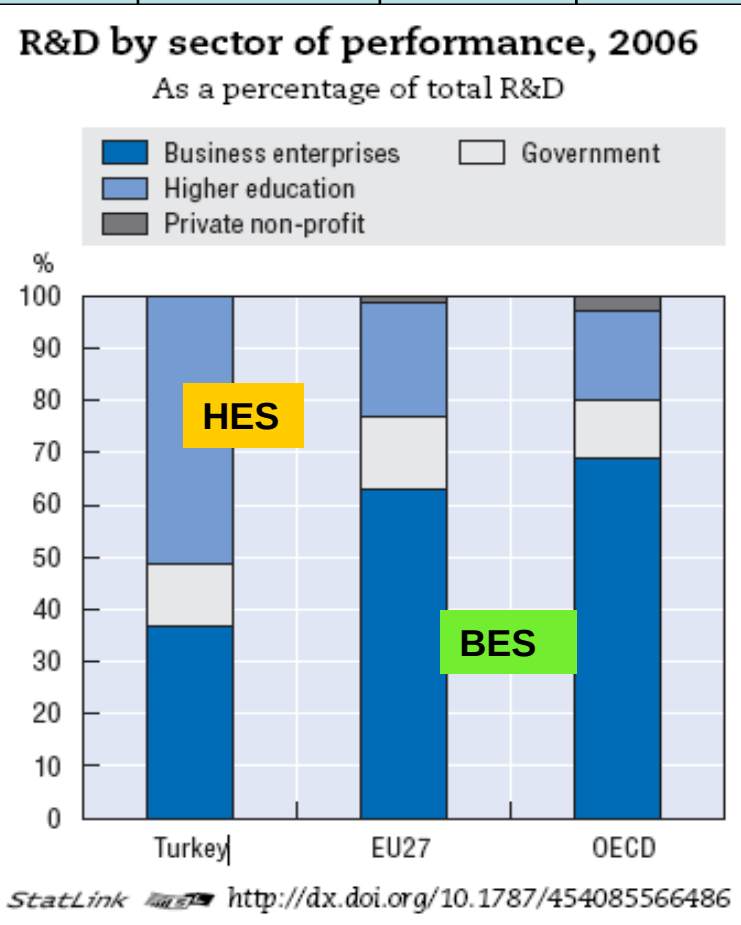




PERCENTAGE OF GERD FINANCED BY INDUSTRY, GOVERNMENT and ABROAD

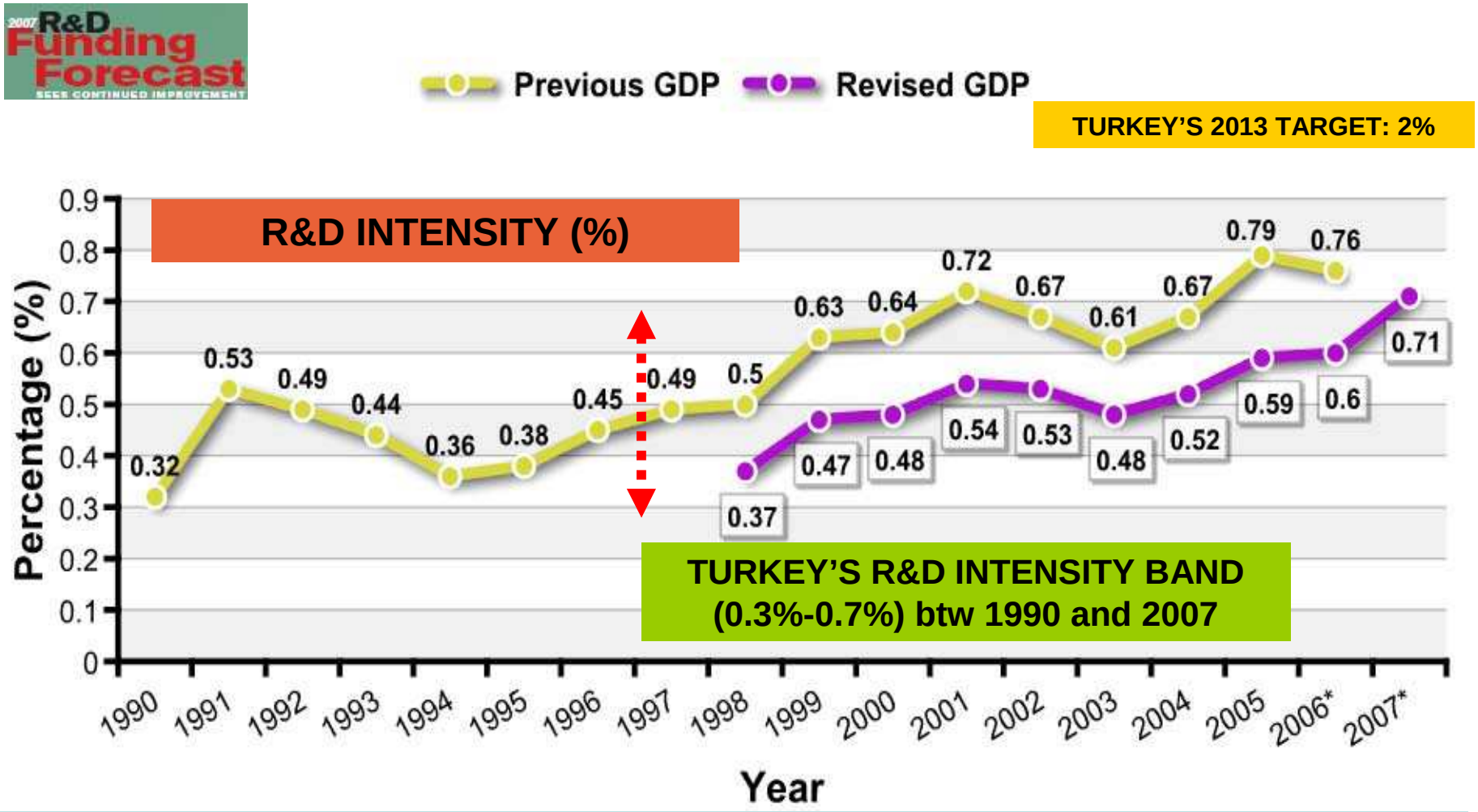
	TURKEY	EU-27	OECD	USA	JAPAN	CHINA	EU-27 / TURKEY RATIO
PERCENTAGE OF GERD FINANCED BY BES (2005) RANK in EU	43.3** 16/30**	63*	68.8*	63.7**	74.8**	65.7**	1.45
PERCENTAGE OF GERD FINANCED BY GOV (2005) RANK in EU	50.1 10/29	34.2					0.68
PERCENTAGE OF GERD FINANCED BY ABROAD (2005) RANK in EU	0.8 29/29	9					11.25

R&D is MAINLY PERFORMED by HES in TURKEY and BY BES IN OECD and EU.



*** OECD ** Eurostat and *** TurkStat data**

GERD as a Percentage of GDP (Turkey)



Source: TurkStat (www.tübitak.gov.tr)

* For the 2006 and 2007 values by revised GDP, gross salaries are used for calculation of R&D labour cost in higher education sector Note: Revised GDP was announced on March 08, 2008 by TurkStat

TURKISH RESEARCH AREA (TRA)

Main Objectives of Turkish Research Area:	Basic Targets of Turkish Research Area:
❖ To increase the quality of life in Turkey ❖ To find solutions to social problem. ❖ To increase the competitive power of our country ❖ To create awareness and interest in S&T in the society	❖ To increase the share of R&D expenditures in GDP ❖ To increase the demand for R&D ❖ To increase the number and the quality of R&D personnel

TRA that scientific community, business and citizens need should have the following features:

An adequate flow of competent researchers World class research infrastructures A wide opening of the European Research Area to the world	Effective knowledge sharing Excellent research institutions Well-coordinated research programmes and priorities

CRITICAL R&D SECTORS FOR TURKEY

There are 12 critical R&D sectors for Turkey.

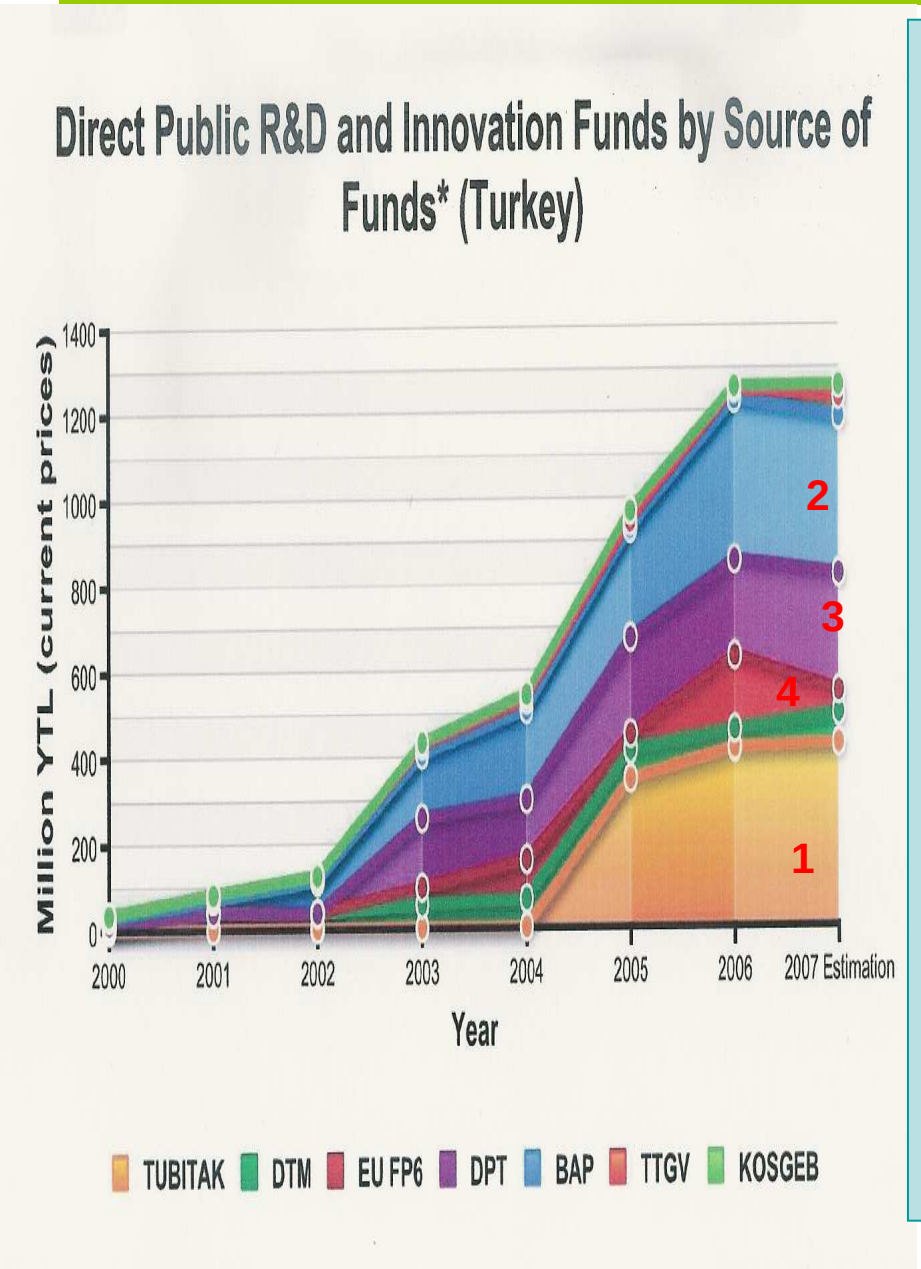
• Information Technologies (IT)	• Energy Technologies
• Telecommunication	• Robotic, automation
• Transportation	• Textiles
• Water sciences	• Modern manufacturing processes
• Environment	• Mining
• Agriculture and biotechnology	• Space, aviation and defense

TURKEY'S PROGRAMME FOR ALIGMENT WITH THE ACQUIS (2006-2013)

CHAPTER 25: SCIENCE and RESEARCH

2006 PROGRESS REPORT	2007 PROGRESS REPORT
IMPROVMENT/ON THE UPGRADE - Research environment, - Cooperation with EU on ERA activities, - Increase in funding of R&D, - Increase in TUBITAK management capacity ***LIMITED IMPROVEMENT*** - Joining of SMEs and BES to FP6. ***NO IMPROVEMENT AT ALL*** - There is a constitutional legal problem with the appointment of the science and technology assembly members.	***IMPROVMENT/ON THE UPGRADE*** - Research policy, - Joining to the FP6, - Integration of Turkey to the ERA. ***LIMITED IMPROVEMENT*** - Joining to the FP7.

RESOURCES AVAILABLE for R&D in TURKEY



SYSTEMATIC INVESTMENT for R&D SPENDING in TURKEY

DOMESTIC RESOURCES FOR R&D

- 1. TUBITAK (Turkish Scientific and Technological Research Council)
- 2. BAP (University Resources)
- 3. DPT (State Planning Organization)
- Contract research funded by Public Sector
- Contract research funded by Private Sector

INTERNATIONAL RESOURCES FOR R&D

- 4. EU Framework Programs (Starting from FP6)
- Others

What are the MAIN PROBLEMS to be solved?

- Poor systematic R&D investment
- Insufficient infrastructure
- Lack of high quality human resources
- Lack of R&D and innovation culture

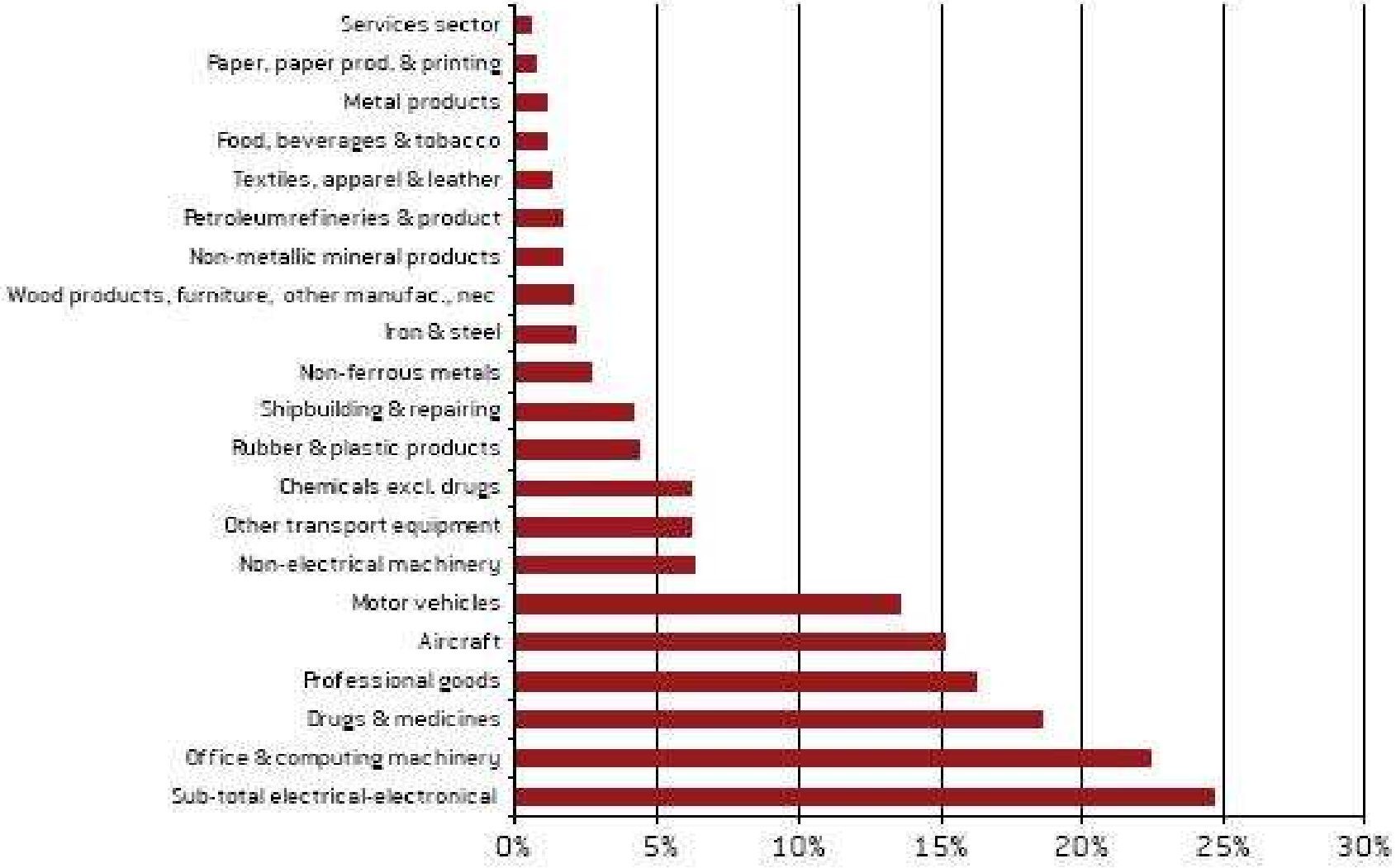
R&D → Economic Growth (Italy, Japan, Germany)

Economic Growth → R&D (USA, Canada, Danmark, France)

WHAT SHOULD TURKEY DO?
WHY IS TURKEY LAGGING BEHIND?

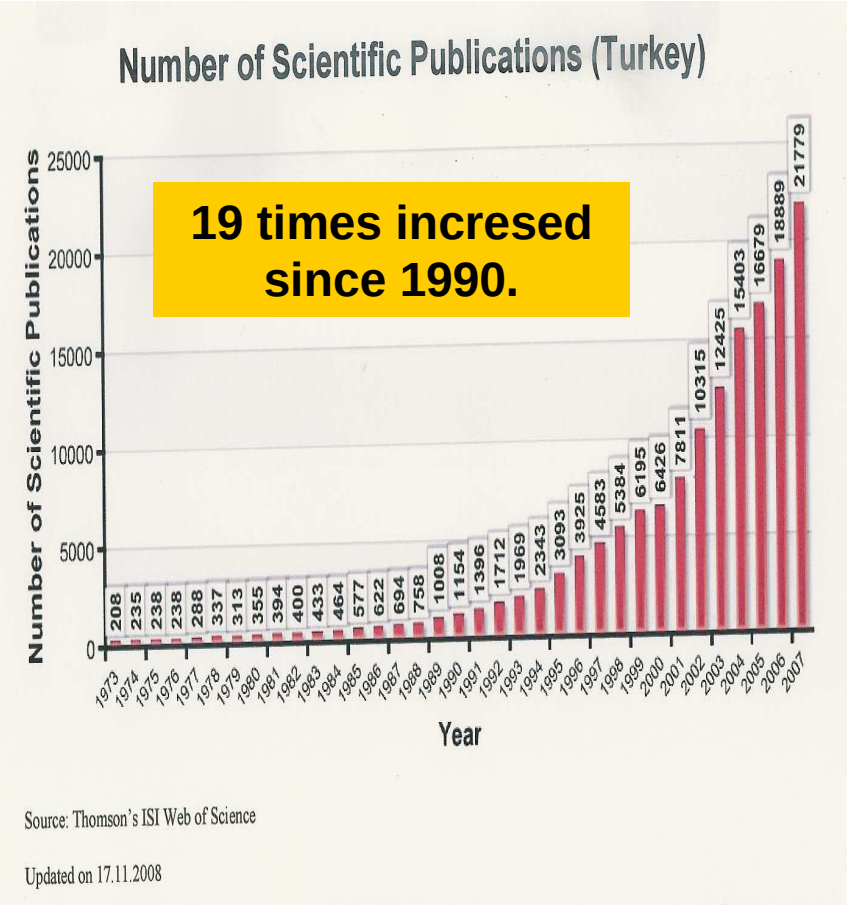
- **Industrial Organization**: The primary sectors of Turkish industry rely more on labor intensive industries thus do not demand R&D activity**.** Generally, Turkish private sector is dependent on transfer of technology to produce up-to-date products in many sectors, except in food processing, ceramics and white&brown products.
- **SME Policies:** Due to limited reserve of personal savings, inadequacy of the capital market and lack of venture companies in Turkey, it is very difficult for SMEs to find investment capitals. SMEs are predominantly depending on their own capitals. Thus, they do not have funds for R&D, education, technology needs. The share of Turkish SMEs in export is 10-15%. Competitive pressures for R&D are missing.
- **Problems with Education System and Human Resource Development in Turkey:** Vocational training, School-business cooperation , Certification and skill formation, Occupational training. Democratisation/masification of HE, Rise of knowledge economy, Globalization and Competition.
- **Lack of Systematic R&D Policy, University-Industry Cooperation:** Coordination, flexibility, bureaucratic obstacles, psychological barriers, insufficent wages, old infrastructures etc.

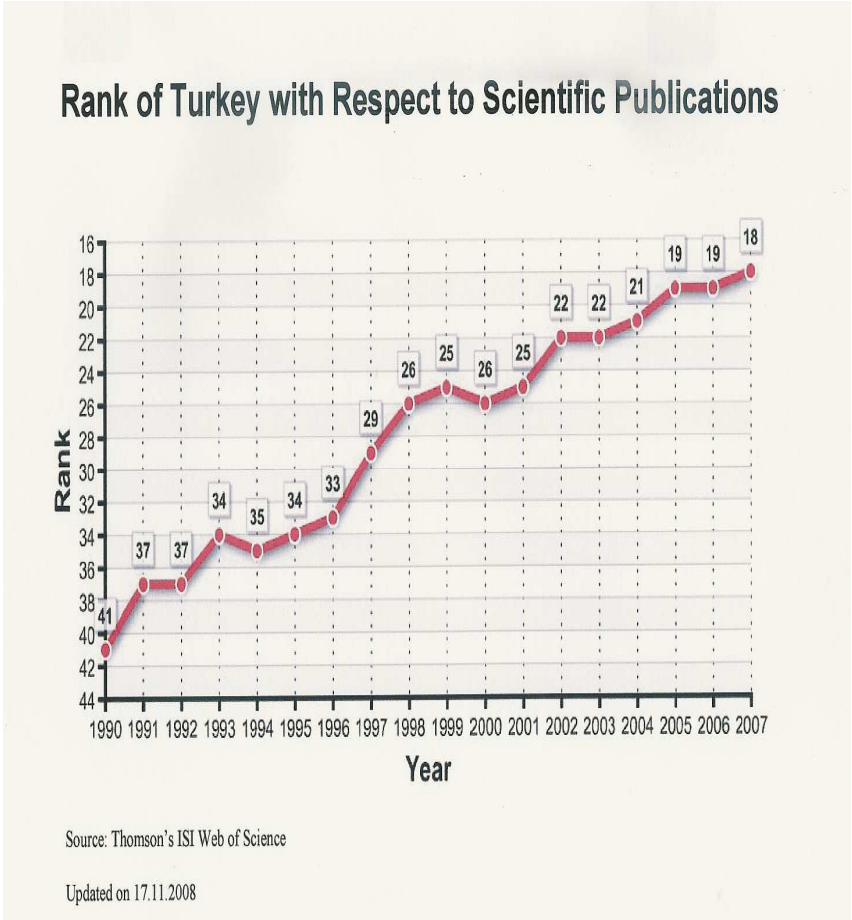
Figure 4: R&D intensity by industry, average across ten countries



Source: Mathieu and van Pottelsberghe based on OECD, ANBERD and STAN databases (2005).

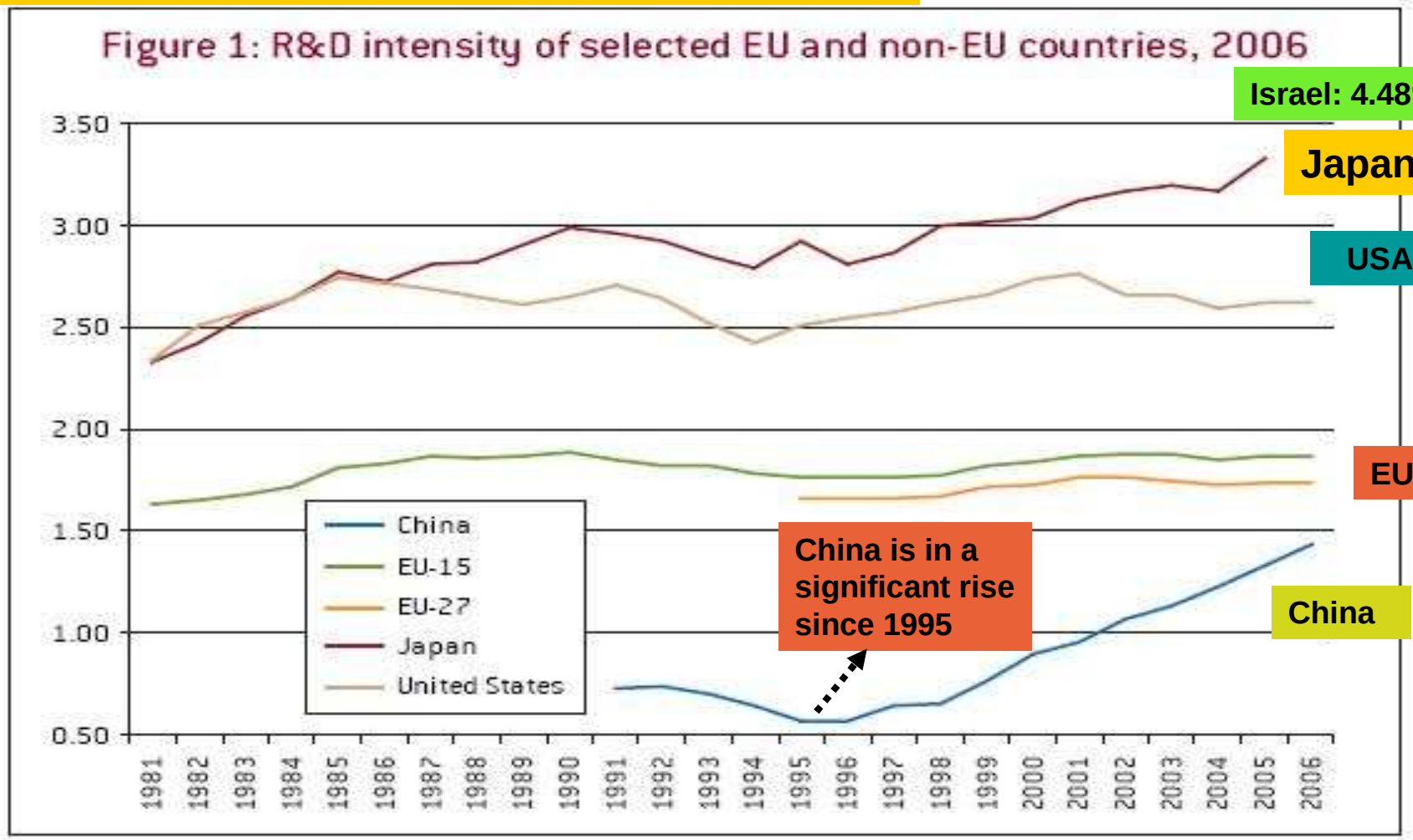
NUMBER of SCIENTIFIC PUBLICATIONS and TURKEY'S RANK in the WORLD





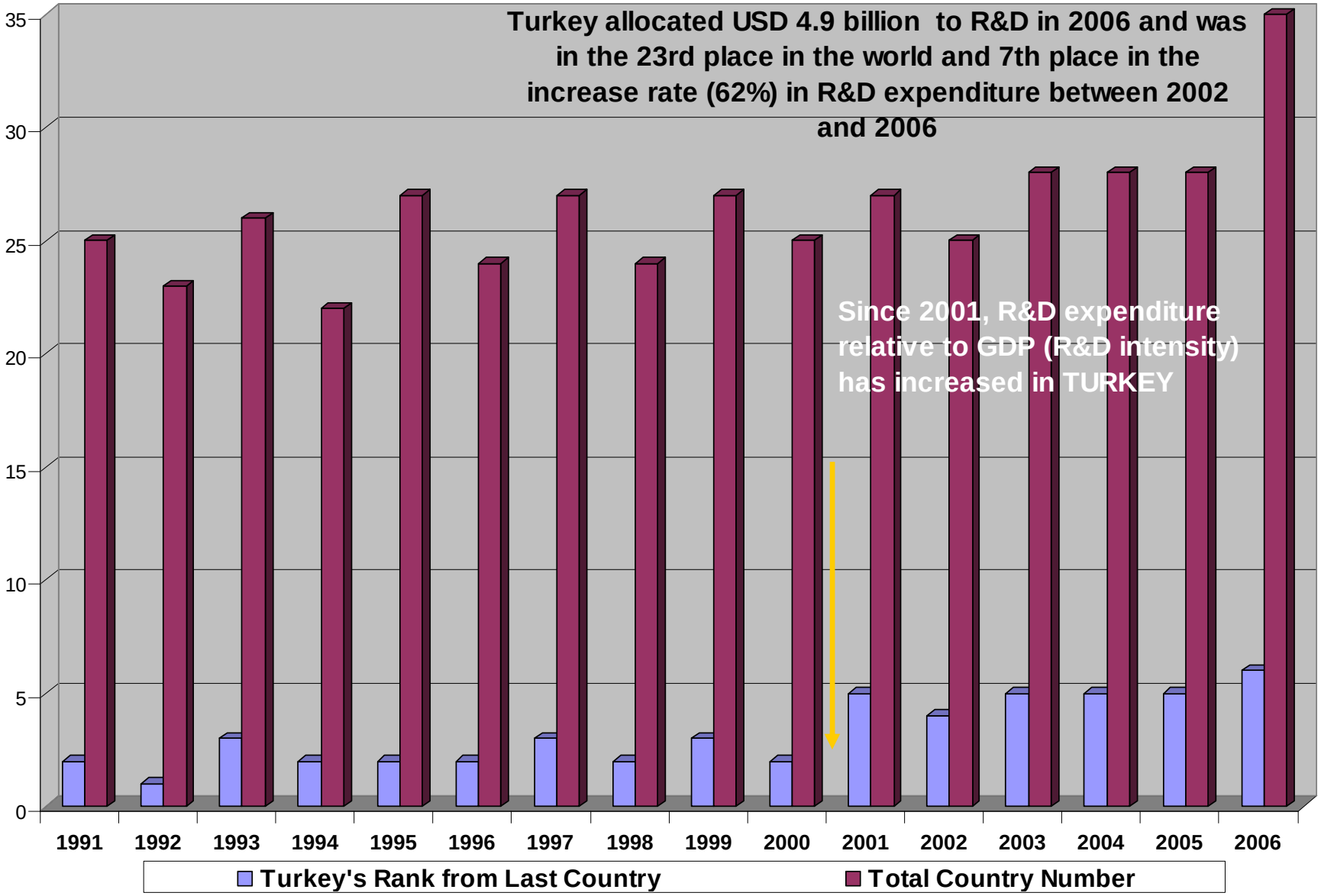
Turkey achieved 83% increase in scientific publications in the world. Turkey is in the 3rd place in the world in the increase rate in scientific publications and in the 18th place in the number of publications in the world.

Evaluation of global share of total R&D, 1981-2006

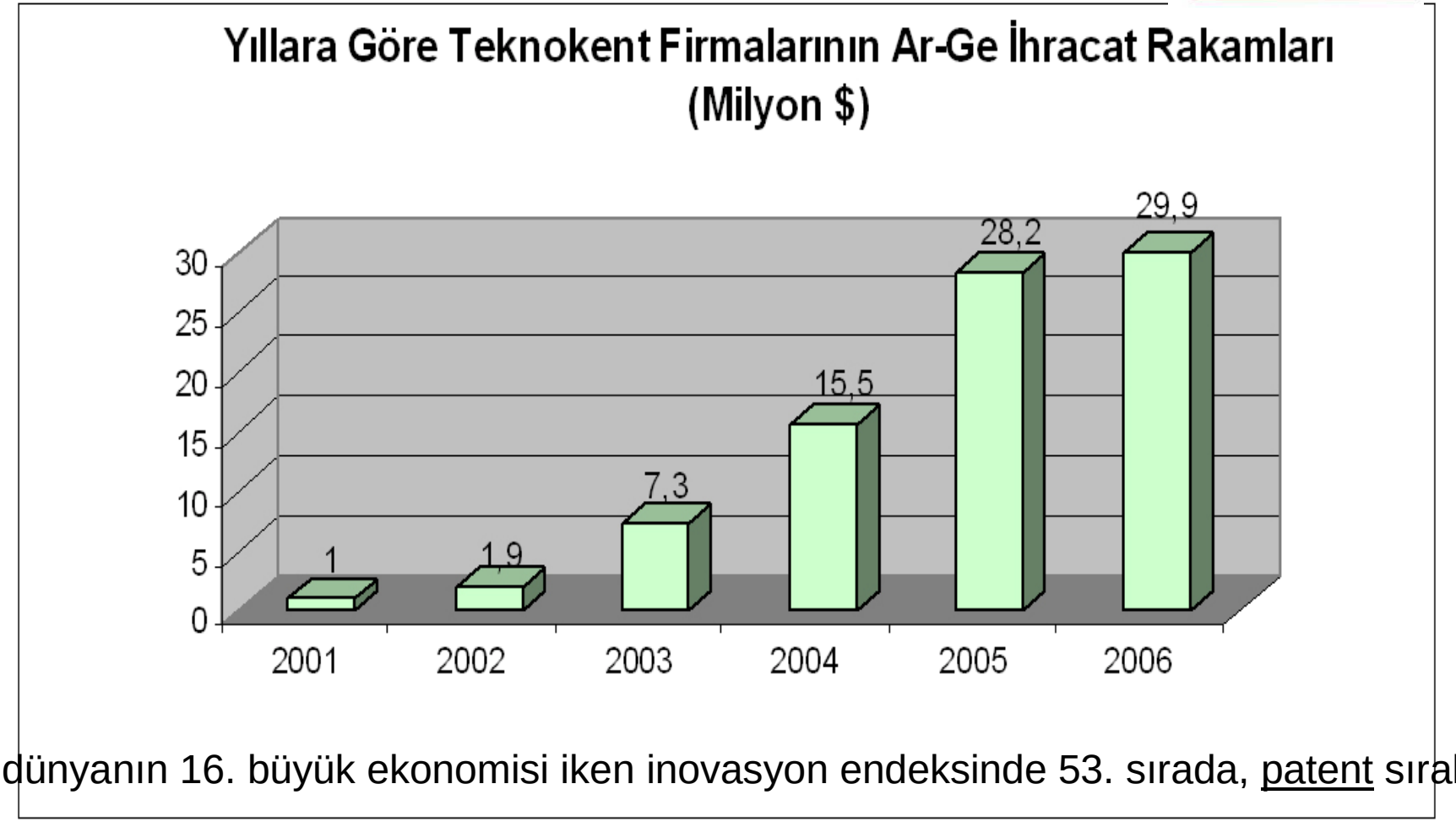


Source: OECD, MSTI, 2007. The figures are gross expenditures on R&D as a percentage of GDP. The 2006 figures for the EU have been extrapolated from Eurostat figures. OECD sources are used because they provide comparable figures for China, Japan and the US.

TURKEY'S RANK IN R&D EXPENDITURE IN OECD BETWEEN 1991 and 2006



BEYİN GÖÇÜNE KARŞI
BEYİN GÜCÜNÜ
TEŞVİK EDİYORUZ.



ırkiye dünyanın 16. büyük ekonomisi iken inovasyon endeksinde 53. sırada, patent sıralam