ERAWATCH COUNTRY REPORTS 2010:

Turkey

ERAWATCH Network – Technopolis Group Turkey

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Acknowledgements and further information:

This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). ERAWATCH is a joint initiative of the European Commission's Directorate General for Research and Innovation and Joint Research Centre.

The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) with contributions from Directorate General for Research and Innovation and the ERAWATCH Network Asbl. The report has been produced by the ERAWATCH Network under contract to JRC-IPTS. This report was produced in November 2010, making use of the data available at that moment and is focused on developments taking place in the previous twelve months.

In particular, it has benefited from comments and suggestions of Lena Tsipouri, who reviewed the draft report. The contributions and comments of Nida Kamil Özbolat from JRC-IPTS and DG-RTD are also gratefully acknowledged.

The report is currently only published in electronic format and available on the ERAWATCH website. Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

Executive Summary

Turkey has a dynamic economy which ranks 17th in the 2010 list of world economies (IMF, 2011)[1]. The country has a population of 73.7m (TURKSTAT, 2011)[2], accounting for 14.7% of the population of the EU-27 (Eurostat, 2011)[3]. 67% of the population is between 15-64 years of age. The gross domestic product (GDP) of Turkey in 2010 was €508,092m[4] (TL1,105,101m). The annual average growth was 5% between 2002 and 2010, based on real GDP[5]. For the year 2010, GDP rose by 8.9% at constant prices from -4.5% in 2009, suggesting a recovery from the global financial crisis (Undersecretariat of Treasury, 2011).

Turkey continues to increase its research and development (R&D) investments since the turn of the century. The gross expenditure on R&D (GERD/GDP) ratio increased by 44% over the last five years. The R&D intensity was 0.85% in 2009 (TURKSTAT, 2010). Between 2005-09 R&D performed by the business sector increased by 18% (from 33.8% in 2005 to 40% in 2009). There was 8.6% increase in R&D performed by universities in the same period. R&D performed by universities decreased by 13% between 2005-2009. These changes are in line with the government policies which aim to increase the share of business sector in R&D intensity to 55% by 2013 (BTYK, 2008)[6].

Existing research policy mix mainly focuses on resource mobilisation and knowledge production. They aim to address two key weaknesses: the low levels of R&D investments and the scarcity of human resources for research. The relatively low levels of absorptive capacity of the private sector (particularly that of micro and small enterprises) and the weak culture of research community-business collaboration are the two main barriers to increase the private R&D investments. There is a need develop a more balanced policy mix by addressing these weaknesses.

Knowledge Triangle

Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	A new S&T and innovation strategy document covering period 2011-16 was issued in December 2010.	• Existence of ambitious research policy goals and high level commitment to implement policies. • Existence of higher resources to implement policy actions. • Need to increase interactions between research community and business sector, and stimulate research commercialisation. • Need to conduct systematic monitoring and evaluation.

[1] http://www.imf.org/
[2] http://www.tuik.gov.tr/PreTablo.do?tb_id=39&ust_id=11
[3] http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/3-27072010-AP/EN/3-27072010-AP-EN.PDF
[4] €1=TL2.175
[5] http://www.hazine.org.tr/en/economy/ogrowth.php
[6] http://www.tubitak.gov.tr/tubitak_content_files//BTYPD/btyk/17/17btyk_karar.pdf

	Recent policy changes	Assessment of strengths and weaknesses
Innovation policy	A new S&T and innovation strategy document covering period 2011-16 was issued in December 2010.	• Need to develop a balanced policy mix also by focusing on increasing the levels of absorptive capacity of the business sector, particularly that of micro and small enterprises. • Need to increase sectoral and regional focus in policies and policy actions. • Need to conduct systematic monitoring and evaluation.
Education policy	No remarkable recent changes	• Need to balance supply and demand in HRST. • Need to increase the number of S&T graduates. • Need to conduct systematic monitoring and evaluation.
Other policies	No remarkable recent changes	• Need to place innovation at the heart of other policy areas. • Need to conduct systematic monitoring and evaluation.

European Research Area

Turkey is at the stage of accession negotiations for EU membership and the process of the harmonisation of the EU *acquis* is underway. Although not a Member State yet, R&D targets of Turkey are in parallel with the ERA targets. Among the 35 topics to be discussed at the negotiation process, the first screening topic that was closed has been the "Science and Research" chapter, as of January 2011[7].

The ERA developments are closely followed by the policy makers and many of the newly introduced policy measures are inspired by their counterparts in the EU programmes. Most importantly, the Supreme Council of Science and Technology (BTYK) launched the “Turkish Research Area” (TARAL) in 2004 with inspiration from the ERA. TARAL, a platform for public, private and NGO stakeholders to coordinate future R&D priorities and collaboration, is aimed to be integrated with the ERA. In this respect, Turkey participates in the common programmes and is determined to be involved in the initiatives carried out at the European level. The need for further improvement of policy coordination across policy levels and policy areas within the knowledge triangle is the main challenge in relation to ERA development.

[7] http://ec.europa.eu/enlargement/candidate-countries/turkey/eu_turkey_relations_en.htm

Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• 'Advisory Board for Science and Technology Human Resources Strategy' was established in order to ensure that Turkey becomes a centre of attraction for HRST. • Actions were taken by the 'International Researcher Committee' to address the needs of foreign researchers.	• Need to increase supply for science & engineering matching the market demand. • Need to increase attractiveness of working conditions for researchers and academic staff.
2	Increase public support for research	• The government continues to allocate high resources for R&D.	• Increased levels of public support for R&D. • Need to increase R&D expenditures.
3	Increase European coordination and integration of research funding	• Increased effort to benefit from FP7 funding	• Integration of TARAL with ERA is given high importance. • Active ERA-NET participation.
4	Enhance research capacity across Europe	• A new S&T and innovation strategy document covering period 2011-16 aims to create more output from existing research capacity and enhance needs-oriented research capacity.	• Increased political commitment to enhance research capacity. • Need to increase R&D investments.
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• Increased efforts to benefit from existing infrastructures and to establish new ones.	• Increase in the public finance allocated to develop world-class research infrastructures. • Active participation in the ESFRI.
6	Strengthen research institutions, including notably universities	• The new S&T and innovation strategy document aims to strengthen R&D infrastructure and capacities at universities.	• Need to focus on the third mission at universities.
7	Improve framework conditions for private investment in R&D	• The new S&T and innovation strategy document aims to improve IPR enforcement.	• Increased efforts to streamline processes in private sector R&D support programmes. • Need to enrich the policy mix (for example by introducing innovation-oriented procurement).

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
8	Promote public-private cooperation and knowledge transfer	• The new S&T and innovation strategy document focuses creating mechanisms for technology transfer and collaborative R&D.	• Need to create new structures like knowledge transfer offices in line with the international good practices. • Need to improve the regulations to increase the attractiveness of academia-business collaborations for university researchers.
9	Enhance knowledge circulation across Europe and beyond	• Increased efforts to integrate TARAL with ERA.	• High commitment for the participation in intergovernmental organisations and schemes, mainly at the EU level.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• Increased efforts for enhanced international cooperation in S&T.	• High number of bilateral agreements with third countries. • High level of commitment for increasing international S&T cooperation. • Need to raise awareness and develop capabilities of research community and business sector to take part in international projects.
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• Increased efforts to coordinate research and innovation policies under the new S&T and innovation strategy document.	• Existence high level commitment to implement policies. • Existence of higher resources to implement policy actions. • Need to increase interactions within the knowledge triangle. • Need to conduct systematic monitoring and evaluation.
12	Develop and sustain excellence and overall quality of European research	• The new S&T and innovation strategy document aims to increase the quality of research.	• Positive trends in the performance of the national research system. • Need for the use of techniques such as international benchmarking and evaluation on the basis of international criteria.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	• The new S&T and innovation strategy document focuses on mechanisms for creating and diffusing knowledge.	• Need to enhance evidence-based policy-making practices to identify and address knowledge demand. • Need for systematic monitoring of demand.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• Energy, water and food are determined as the areas to focus by the BTYK and also in the new S&T and innovation strategy document.	• Need to enrich the policy mix with measures addressing societal challenges.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• The new S&T and innovation strategy document highlights the need for disseminating S&T culture at the society and promoting science and society activities.	• Existence of efforts and policy measures to build mutual trust between science and society. • Need to develop and implement tools to strengthen scientific evidence for policy making.

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1 Introduction

The main objective of the ERAWATCH Analytical Country Reports 2010 is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals and of the 2020, post-Lisbon Strategy. The assessment will focus on the national R&D investments targets, the efficiency and effectiveness of national policies and investments into R&D, the articulation between research, education and innovation, and on the realisation and better governance of ERA. In doing this, the 15 objectives of the ERA 2020 are articulated.

The report builds on the 2009 report streamlining the structure and updating the 2009 policy assessment in the domains of human resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. The information related to the four ERA pillars covered in the 2009 report is also updated and it is extended in order to cover all six ERA pillars and address the corresponding objectives derived from ERA 2020 Vision.

Given the latest developments, the 2010 Country Report has a stronger focus on the link between research and innovation, reflecting the increased focus of innovation in the policy agenda. The report is not aimed to cover innovation per se, but rather the '**interlinkage**' between research and innovation, in terms of their wider governance and policy mix.

2 Performance of the national research and innovation system and assessment of recent policy changes

The aim of this chapter is to assess the performance of the national research system, the **'interlinkages'** between research and innovation systems, in terms of their wider governance and policy and the changes that have occurred in 2009 and 2010 in national policy mixes in the perspective of the Lisbon goals. The analysis builds upon elements in the ERAWATCH Country Report 2009, by updating and extending the 2009 policy assessment in the domains of resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. Each section identifies the main societal challenges addressed by the national research and innovation system and assesses the policy measures that address these challenges. The relevant objectives derived from ERA 2020 Vision are articulated in the assessment.

2.1 Structure of the national research and innovation system and its governance

This section gives the main characteristics of the structure of the national research and innovation systems, in terms of their wider governance.

The Turkish economy ranks 17th in the 2010 list of world economies (IMF, 2011)[8]. The country has a population of 73.7m (TURKSTAT, 2011)[9], accounting for 14.7% of the population of the EU-27 (Eurostat, 2011)[10]. 67% of the population are between 15-64 years of age and half is younger than 29. The gross domestic products (GDP) of Turkey in 2010 was €508,092m (TL1,105,101m), with an annual average growth of 5% between 2002 and 2010. GDP growth rate in 2009 was -4.5% comparable to that of the EU-27 (-4.2% in 2009). However, it rose by 8.9% in 2010 at constant prices (Undersecretariat of Treasury, 2011)[11]. The 2002-2010 period has also put an end to high inflation, which was decreased from around 70% at the beginning of 2002 to 9.1% as of May 2010 (ISPAT, 2011)[12].

The R&D intensity in Turkey was 0.85% in 2009 (TURKSTAT, 2010). Although the gross expenditure on R&D (GERD)/GDP ratio increased by 60% between 2002 and 2009, it is still below the EU-27 average of 1.85%. Nevertheless Turkey continues to increase its research and development (R&D) investments. The number of full-time equivalent (FTE) R&D personnel increased to 73,521 in 2009 from 23,995 in 2002, according to TURKSTAT.

Main actors and institutions in research governance

Turkey has a well-developed national research system that encompasses most of the actors and institutions that exist in the EU countries. The system is led by the Supreme Council of Science and Technology (BTYK), a legally formalised body chaired by the prime minister. The BTYK determines, directs and co-ordinates research and innovation policies, mainly through its six monthly regular meetings. The council is composed of relevant ministers, heads of public and private bodies, universities and non-governmental organisations. The Scientific and Technological Research Council of Turkey (TUBITAK) is affiliated to the Prime Ministry and acts as the secretariat of the BTYK. The State Planning Organisation (DPT) and the High Planning Council (YPK) are two other important actors in the design and implementation of science, technology and innovation policies. The Ministry of National Education (MoNE) and the Higher Education Council (YOK) design and implement education policies, and integrate them with research policies. The Turkish Academy of Sciences (TUBA) determines and recommends scientific priority areas and proposes legislation to the government on issues related to scientists and researchers.

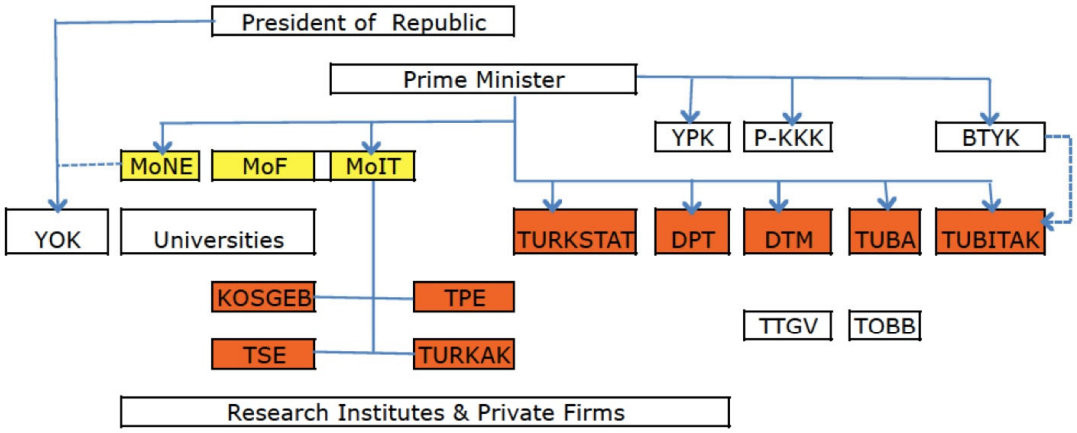
At the operational level, the leading actor in the system is TUBITAK. It designs and implements programmes supporting R&D activities of the public and private sectors and universities. The Ministry of Industry and Trade (MoIT), the Small and Medium Enterprises Development Organisation (KOSGEB) and the Technology Development Foundation of Turkey (TTGV) are the other main bodies implementing industrial R&D support measures. The Turkish Patent Institute (TPE) carries out the procedures related to industrial and intellectual property rights. The Turkish Accreditation Agency (TURKAK) deals with the accreditation of organisations and laboratories. The Turkish Standards Institute (TSE) implements activities related to standards preparation, testing and certification. The Union of Chambers and Commodity Exchanges of

[8] http://www.imf.org/
[9] http://www.tuik.gov.tr/PreTablo.do?tb_id=39&ust_id=11
[10] http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/3-27072010-AP/EN/3-27072010-AP-EN.PDF
[11] http://www.hazine.org.tr/en/economy/ogrowth.php
[12] http://www.invest.gov.tr/en-US/investmentguide/investorsguide/Pages/MacroEconomicIndicators.aspx

Turkey (TOBB) acts as an intermediary between the private sector and rest of research system.

The primary research performer in the public sector is the Marmara Research Centre of TUBITAK. It provides contractual research, testing, training, consultancy, analysis and certification services in its research centres, and operates a technopark. TUBITAK's institutes are the most active research organisations conducting research in their fields of specialisation. For nuclear research activities, the Turkish Atomic Energy Institute is the main body both for strategy preparation and for carrying out research activities. There are also the R&D centres operating under universities and various ministries, such as the ministries of Energy and Natural Resources, and Agriculture and Rural Affairs. Universities are also leading actors in the system as the key group of research performers. There are 146 universities of which 51 are privately owned.

Figure 1: Overview of the Turkey's research system governance structure



BTYK- Supreme Council of Science and Technology
YPK- High Planning Council
P-KKK - Money-Credit and Coordination Council
MoF: Ministry of Finance
MoIT-Ministry of Industry and Trade
MoNE- Ministry of National Education
DPT- State Planning Organization
TUBITAK- Scientific and Technological Research Council of Turkey

YOK- Higher Education Council
TUBA- Turkish Academy of Sciences
TSE- Turkish Standards Institute
TURKSTAT- Turkish Statistical Institute
DTM- Undersecretariat of the Prime Ministry for Foreign Trade
TTGV- Technology Development Foundation of Turkey
TURKAK- Turkish Accreditation Agency
TPE- Turkish Patent Institute
TOBB-Union of Chambers and Commodity Exchange of Turkey

Source: ERAWATCH Research Inventory

The institutional role of regions in research governance

Turkey is a unitary state where all policy fields and their governance, including research, are under the responsibility of the central government. On the other hand, the regional development agencies, which operate under the coordination of the State Planning Organisation, design and implement programmes for stimulating R&D in their regions, although they are not given a direct responsibility on this matter.

Main research performer groups

Traditionally the higher education sector is the largest research performer in Turkey. In 2009, R&D expenditures performed by the higher education sector was 47.4%. The private sector accounted for 40% of the R&D expenditures performed in the same year. The public research as a share of total R&D expenditures was reported as 12.6% in 2009 (TURKSTAT, 2010).

2.2 Resource mobilisation

Since 2000, Europe has made evident progress towards ERA but at the same time it is clear that Europe's overall position in research has not improved, especially regarding R&D intensity, which remains too low. The lower R&D spending in the EU is mainly a result of lower levels of private investment. Europe needs to focus on the impact and composition of research spending and to improve the conditions for private sector R&D investments.

This section assesses the progress towards national R&D targets, with particular focus on private R&D and of recent policy measures and governance changes and the status of key existing measures, taking into account recent government budget data. The need for adequate human resources for R&D has been identified as a key challenge since the launch of the Lisbon Strategy in 2000. Hence, the assessment includes also the human resources for R&D. Main assessment criteria are the degree of compliance with national targets and the coherence of policy objectives and policy instruments.

2.2.1 Resource provision for research activities

The aim of this section is to paint a picture of national public research funding and the various funding modes and mechanisms prevalent in your country.

Achieving an R&D intensity of 2% by 2013 (from 0.53% in 2002) is the primary target set in 2005 for R&D in Turkey. In order to reach this target the government started to increase funds allocated for R&D activities. The total amount of public funds earmarked in the seven years between 2003 and 2010 was approximately €3,264m[13] (TL6,985m). The amounts allocated for R&D in the state budget have not been cut but increased during the global financial crisis: funds allocated in 2008, 2009 and 2010 were €528.4m[14] (TL1,004m), €622.3m[15] (TL1,388m) and €654.6m[16] (TL1,342m), respectively.

This, along with other factors like economic growth, has caused R&D intensity from 0.53% in 2002 to 0.85% in 2009. Total gross expenditure on R&D (GERD) of Turkey has increased almost 2.9 times from 2000 to 2009 on TL basis reaching €3.626m (TL8,087m), in 2009, according to the R&D statistics of the TURKSTAT (2010).

Since the early 2000s, Turkey's R&D strategy has been shaped by a number of plans and policy documents. These include:

- The technology foresight (the Vision 2023 project) implemented between 2002 and 2004;
- The science and technology (S&T) targets set at the BTYK meeting in 2004;
- The five-year implementation plan for the National Science and Technology Strategy (2005–2010) approved by the BTYK in 2005;
- The Ninth Development Plan (2007–2013), which was issued by the State Planning Organisation in 2006.

[13] €1=TL2.14
[14] €1=TL1.90
[15] €1=TL2.23
[16] €1=TL2.05

A new S&T and innovation strategy, covering period 2011-2016, was approved by the BTYK in December 2010. The BTYK documents are the leading policy documents in the research system. While these documents emphasise the need for continued budget allocations for reaching the 2013 targets, they do not spell out multi-annual budget plans.

The backbone of the current S&T policies and priorities is the Vision 2023 project. The process for the project included an analysis of the strength and weaknesses at national level, among others.

The main funding instruments to implement the S&T policies cover the following:

- The 'Support Programme for Industrial R&D Projects' which aims to increase R&D activities of the private sector and is implemented by TUBITAK;
- The 'Support Programme for Research Projects of Public Institutions' implemented by TUBITAK with the aim of supporting R&D projects of public bodies;
- The 'Support Programme for the Scientific and Technological Research Projects' of TUBITAK which provides finance to research projects, mainly of academia;
- The 'Industrial Thesis (San-Tez) Projects' support programme of the MoIT which was designed to bridge the gap between the industry and academia;
- Tax incentives provided for the private sector R&D under the 'Law on Supporting Research and Development Activities' and the 'Law of Technology Development Zones' implemented by the MoIT in collaboration with the Ministry of Finance;
- The 'R&D, Innovation and Industrial Application Support Programme' of KOSGEB which aims to support research and innovation activities of SMEs and entrepreneurs.

In terms of the number of policy instruments, the majority of mechanisms in the policy mix are project-based competitive funding programmes, which provide grants and soft loans to R&D projects of the private sector, academia and public institutions. In a large majority of programmes, collaborations between different actors of the system are not obligatory. In terms of budget, nearly half of the state funding allocated for competitive programmes: In 2010, nearly 47% of the state budget for R&D was allocated to project-based subsidies, while 25% was earmarked for public research institutes and 28% was allocated for universities (BTYK, 2010).

The 'science and society' support actions are implemented by TUBITAK through various mechanisms. Since 2007 the "Science and Society Support Programme" is run to enable teachers and academics to develop and implement projects to promote science in schools and universities. In addition, funding is provided to the establishment of a science centre.

The support mechanisms tend to be generic in nature and a majority of them do not focus on thematic issues. Defence, space and nuclear technologies are the fields supported through thematic schemes. Other than these efforts, it is not possible to talk about societal challenges addressed with separate budget allocation. On the other hand, a recent development on the subject is the decision of the BTYK to in June 2010 taken to prepare national R&D and innovation strategies for the areas of energy, water and food are prepared under the co-ordination of TUBITAK. R&D investments in each of these areas will be promoted under the prime minister's

initiative. The new S&T and innovation strategy document also focuses on thematic areas for R&D investment.

2.2.2 Evolution of national policy mix geared towards the national R&D investment targets

Evolution of BERD

There has been a remarkable increase in the business sector R&D intensity in Turkey in the last five years. BERD almost doubled between 2005 and 2009, from €773.7m (TL1,297m) to €1,451m (TL3,235m), according to the Eurostat and TURKSTAT data. BERD rose steadily until 2008 where it reached €1,604m (TL3,048m). It decreased by 6% in 2009, mainly due to the global financial crisis. The public funding aims at leveraging greater private sector investments. According to the S&T objectives of Turkey, 60% of the 2% GERD/GDP target is expected to be performed by the private sector.

Policy Mixes towards increased private R&D investment

The characterisation of the national policy and instrument mix to foster public and private R&D investment is summarised below. There have not been shifts between routes taken place over the last one year.

Route 1: Promoting the establishment of new indigenous R&D performing firms

As part of the broader industrial and innovation policy framework, the leading programmes aiming to encourage creation of new technology-based firms include the new 'R&D, Innovation and Industrial Application Support Programme' of KOSGEB and 'Technopreneurship Support Programme' of the MoIT. The former is the follow up of the 'R&D and Technological Innovation Support Programme' which was replaced in mid-2010. In 2009-2010 period, the MoIT allocated €9.52m (TL120m) to 180 entrepreneurs started their technology-based business. (BTYK, 2010)

Route 2: Stimulating greater R&D investment in R&D performing firms

The primary focus of the measures in Turkey is on increasing the R&D investments of companies in general. The main instruments implemented for this purpose cover subsidies in the form of grants and soft loans as well as fiscal incentives. The leading measure is the 'Support Programme for Industrial R&D Projects' which aims to increase R&D activities of the private sector and is implemented by TUBITAK. In 2009, €201.3m (TL432.7m) was provided to R&D projects of the private sector. Tax incentives are provided under the 'Law of Technology Development Zones' and the 'Law on Supporting Research and Development Activities'. The former provides tax exemption to R&D activities of tenants of technoparks while the later is used by companies located outside the technoparks and employing at least 50 researchers (in case they have been entitled as "R&D Centre" by the government). As of November 2010, there were 1,451 companies with 12,743 R&D personnel in 28 active technoparks. The MoIT granted the 'R&D centre' status to 80 companies in 2009-2010. Their amount of R&D expenditures in this period was estimated as €1,662m (TL3,491m). (BTYK, 2010) The KOSGEB programme mentioned in route 1 above also covers this route and the route 3 below (since the programme has recently been started it is not possible to provide budget figures).

Route 3: Stimulating firms that do not perform R&D yet

Apart from the above-mentioned KOSGEB support for SMEs, the only scheme available to stimulate firms that do not perform R&D yet is the 'SME Funding Programme' implemented by TUBITAK. It aims to increase the number of R&D projects carried out by SMEs by offering a much faster and easier access for funding. In 2009, €39.5m (TL85m) was provided to the R&D projects of SMEs.

Route 4: Attracting R&D-performing firms from abroad

Attracting FDI is one of the priorities of the government. However, there are no direct measures for pulling research-intensive FDI. The 'Law on Supporting Research and Development Activities' which provides fiscal incentives for R&D activities of firms employing at least 50 researchers is expected to be used as a stimuli to attract foreign firms which would like to locate their R&D branches outside their home countries. The tax exemptions provided under the 'Law of Technology Development Zones' has been instrumental in attracting 54 R&D-performing firms from abroad. Their total amount of investments reached €328.9m (TL450m) as of November 2010. (BTYK, 2010)

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

The topic has been on the political agenda for a very long time. One of the programmes implemented for this purpose is the 'Industrial Thesis (San-Tez) Projects' support programme by the MoIT. In 2009-2010 period, the MoIT provided €13m (TL24.7m) to the projects supported under this programme. Another measure implemented is the TUBITAK's 'Support Programme for the Initiative to Build Scientific and Technological Cooperation Networks and Platforms'. The programme has been inspired from the technology platforms of the European Union. As of January 2010, the funds allocated for ten projects amounts to €2.2m (TL4.62m) (BTYK, 2010). Finally, as a part of the 'Support Programme for Research Projects of Public Institutions', it is possible for public bodies to create consortiums with the private sector, universities or public research institutes to conduct joint R&D activities. Since this programme is more related to the increasing R&D in the public sector (and since R&D collaboration with third parties is not mandatory for public organisations) it is covered under the route 6 below.

Route 6: Increasing R&D in the public sector

Involvement of the public sector in R&D activities is another topic that has been debated for more than a decade. The 'Support Programme for Research Projects of Public Institutions' aims to address the R&D needs of public organisations. As part of the programme, the public administrations need to identify their needs, which could be solved through R&D projects (also see route 5 above). The total budget allocated for supported projects is estimated as €148.5m (TL300m) as of December 2010. (BTYK, 2010)

In the Turkish policy mix, the route 2 has been given higher importance when compared with the number of measures in other routes. In particular, route 1 and route 5 requires higher attention in order to overcome the barrier of scarce public and private sources of early stage finance and to promote research commercialisation from the higher education sector (which is the leading R&D performer)[17] (TrendChart

[17] http://www.proinno-europe.eu/trendchart/extranet/upload/countryreports/Country_Report_Turkey_2009.pdf

Report, 2009). Furthermore, there is a need to enrich the policy mix with new measures aiming to invest in the priority technology fields identified for socio-economic development (UNESCO, 2010).

Support for research and innovation in business

The support programmes implemented to foster R&D investment in the private sector have continuously been improved by the implementing agencies. KOSGEB, for example, radically revised and improved in mid-2010 its R&D and innovation support scheme which has been implemented for SMEs and entrepreneurs since early 1990s. KOSGEB completed in December 2010 the external evaluation of its support schemes following international good practices. TUBITAK has also been streamlining its process in the 'Support Programme for Industrial R&D Projects'. An indicator of the improvement is the evaluation duration of the projects applied for support: it was decreased from 5 months in 2008 to 3.5 months in 2009 and to 3 months as of October 2010 (BTYK, 2010).

Innovation-oriented procurement policies

There are no innovation-oriented procurement policies in Turkey. However, the 'Support Programme for Research Projects of Public Institutions', explained in route 6 above, is considered as a tool to partly address the need for public procurement of innovative goods and services.

Other policies that affect R&D investment

The Coordination Council for the Improvement of Investment Environment[18] works to improve the framework conditions for private investments. The council covers a number of areas from company start-ups to R&D. To increase IPR protection, TUBITAK, in collaboration with TPE, provides financial support for patent applications of Turkish citizens and private companies.

Barrier and risks for attaining the BERD target

The target of achieving 60% of GERD/GDP by the private sector is expected to be reached by 2013 where it is aimed to achieve an R&D intensity of 2%. As noted before, BERD shows a positive trend. The barriers and risks for not reaching this target can be related to the low levels of awareness and capacities on R&D and innovation in micro and small enterprises which forms 97.7% of all firms in the manufacturing sector and 99.7% of those in the services sector; and the limited incentives (including the private finance in the form of venture capital and business angels investments) for the creation of new technology-based firms.

2.2.3 Providing qualified human resources

National context

Increasing the number of R&D personnel is one of the primary objectives of the Turkish S&T strategy. The target for 2013 is to increase the number of full-time equivalent R&D personnel to 150,000 from 23,995 in 2002. According to the latest R&D statistics of TURKSTAT, this figure reached 73,521 in 2009.

[18] http://www.yoikk.gov.tr/eng/

In December 2010, TURKSTAT announced the results of the first 'Careers of Doctorate Holders Survey' conducted in 2009[19]. The results of the survey revealed that one every three PhD holders were female in 2009. The gap between genders decreases as age group decreases. The majority (more than 40%) of PhD holders were in the age group of 35-44. The highest proportion of PhD holders was in medical and health sciences with 37.4% and the lowest proportion was in agricultural sciences with 7.5%. Teaching and/or research assistantship were the most frequent reported source of funds (60.6% of graduates reported they received this type of financial support).

Public funding for human resource development has been increasing in line with the S&T policies of Turkey. YOK, MoNE and TUBITAK are the three major public institutions that provide scholarships. Tax incentives for R&D personnel are applied for those working in technoparks and in 'R&D centres' entitled by the MoIT.

Human resources in S&T (HRST) between the age 25-64 (economically active population in 2007) was 4,413 (in total 1000s). The share of researchers in higher education sector was 29.5% while it was 15.3% and 4.8% in business enterprise and government sectors, respectively (Eurostat, 2010).

Articulation of education policies within the knowledge triangle

There is an increase in the S&T graduates (tertiary graduates in S&T per 1000 persons aged 20-29 years) by 34% between 2002 and 2007 in Turkey, as opposed to 18.6% increase in the EU-27.

Opportunities for life-long learning and job-training are mainly provided by KOSGEB and the Turkish Employment Agency (ISKUR) to individuals and SMEs. There are also life-long learning centres open to public at the majority of universities around the country.

The 'National Science and Technology Human Resources Strategy and Action Plan' that was launched in December 2010 includes strategies to develop HRST according to the R&D needs of the private sector. It is expected that this strategies will be linked with the education policies.

Main societal challenges

There is a need to balance the supply and demand of science and engineering graduates. As one of the areas of priority in the national policies, the government aims to increase the number of human resources for HRST. Both this and the improvement of the distribution of HRST across sectors is the first objective of the 'National Science and Technology Human Resources Strategy and Action Plan'.

The education curricula take into account aspects such as innovation, creativity, creative thinking, problem solving, entrepreneurship skills, etc. These skills are incorporated into various courses starting from the early ages. The compulsory course 'Technology and Design' taught for three years at the primary education level specifically focus on creativity and innovation. Entrepreneurship training is widely available at universities thanks to the courses organised by KOSGEB all over the country.

[19] http://www.turkstat.gov.tr/PreHaberBultenleri.do?id=10697

2.3 *Knowledge demand*

This section focuses on structure of knowledge demand drivers and analysis of recent policy changes.

The demand for knowledge is mainly dependent on the structure of the industry. Turkey has a dynamic economy, characterised by a complex mix of modern industry and commerce and a traditional agriculture sector. The largest industrial sector is textiles and clothing and accounts for one-third of industrial employment. The automotive and electronics industries are growing in importance and have surpassed textiles in Turkey's export composition (OECD, 2010)[20].

Micro enterprises dominate the enterprise sector (93.8% of firms in manufacturing industry and 99.1% of those in services sector are enterprises with less then 10 employees). While their share in the total number of enterprises and employment is high (98.1% and 57.4%, respectively) they account for 28.1% total value added as opposed to 28.8% by small and medium enterprises and 43% by large firms.

As noted above, BERD in Turkey showed a strong performance over the last years. The sub-sectors with the highest percentage of BERD in the manufacturing sector are "Computer, electronic and optical products", "Motor vehicles, trailers and semi-trailers" and "Computer programming, consultancy and related activities", with more than the third of total expenditures.

Turkey is the 15th most attractive destination for Foreign Direct Investment (FDI) in the world, according to UNCTAD World Investment Prospects Survey, 2008-2010. Net FDI inflow over the last five years between 2005-2009 was €58,550m (USD78,801m). The financial intermediation and manufacturing sectors have attracted the highest amount of FDI in this period. The highest amount of FDI was attracted from EU Member States (mainly France, Germany, the UK, Italy and the Netherlands), Gulf Arab countries and the USA[21].

The S&T policies in Turkey seek to increase the R&D and innovation activities in the business sector through a number of measures which were explained under Section 2.2.2 above. While there are no direct schemes to attract knowledge-intensive FDI, the incentives provided in technoparks -to some extent- help attract R&D performing foreign firms.

The knowledge demand for addressing societal challenges and sustainable development has recently been taken into account with the BTYK decision in 2010 on fostering R&D in energy, water and food (see Section 2.2.1). There are no research budget allocations yet for these fields. The need to invest in all areas related to societal challenges and sustainable development is evident from statistics on GERD in relation to Turkey's socio-economic objectives. For example, between 2003 and 2007, government expenditure on R&D only increased from 2.2% to 4.6% for 'control and care of the environment' and from 3.3% to 4.3% for 'production, distribution and rational use of energy' (see UNESCO, 2010 for details).

2.4 *Knowledge production*

The production of scientific and technological knowledge is the core function that a research system must fulfil. While different aspects may be included in the analysis

[20] http://www.oecd.org/dataoecd/40/29/46666009.pdf
[21] http://www.invest.gov.tr/en-US/investmentguide/investorsguide/pages/FDIinTurkey.aspx

of this function, the assessment provided in this section focuses on the following dimensions: quality of the knowledge production, the exploitability of the knowledge creation and policy measures aiming to improve the knowledge creation.

2.4.1 Quality and excellence of knowledge production

Total GERD of Turkey has increased almost 2.9 times from 2002 to 2009 on TL basis reaching €3.626m (TL8087m) in 2009. According to TURKSTAT, 41.0% of R&D expenditures were financed by business enterprises, 34.0% by government sector, 20.3% by higher education sector, 3.7% by other national sector and 1.1% by foreign funds in 2009. Funds from the state budget for research projects are allocated for R&D activities of both public (public research institutions and universities) and private sectors. Of the total amount of €3,463m earmarked between 2003 and 2009, the funds set aside for the research activities of the public sector were €2,589m, while the rest was allocated by the government for the R&D activities of private sector companies.

As noted before, universities perform a significant proportion of Turkey's R&D spending and employ the majority of researchers. 146 universities employ around 80,000 academic staff and the total number of students is around 2 million. According to the statistics provided by the MoNE, there were 424,330 female and 500,206 male students attending to state universities in the period 2008-2009. The numbers of female and male students attending PhD degree programmes in the same period were 15,034 and 18,713, respectively. Between 2003 and 2009, total funding provided through the S&T sector investment budget for HEIs allocated by DPT was €1,072m (TL1,951). The funding provided by the Ministry of Finance in the same period for research through the budgetary allocations was €989m.

The other significant stakeholders for knowledge production in the Turkish research system include the public research institute and private research centres established in and out of technology parks. There are more than 100 public research institutions in Turkey with around 2,000 researchers. According to the 2009 R&D survey results of the TURKSTAT, it is estimated that 11,007 FTE R&D personnel are employed by the public sector, which constitute 14.97% of all the researchers in Turkey. Public research as a share of total R&D expenditures has increased from 8% in 2005 to 12.09% in 2009.

The most active public research institutes are those established by the Scientific and Technological Scientific and Technological Research Council of Turkey (TUBITAK): The Marmara Research Centre, the Space Technologies Research Institute, the Defence Industries Research and Development Institute, the National Electronics and Cryptology Research Institute, and the Basic Sciences Research Institutes[22]. The General Directorate for Agricultural Research, which is affiliated to the Ministry of Agriculture and Rural Affairs, is also one of the biggest public research organisations having seven central and nine regional research institutes, and 34 thematic research institutes[23]. Another important public organisation associated with research is the Atomic Energy Council of Turkey (TAEK)[24]. In addition, there are R&D centres (Refik Saydam Hifzissihha Centre) under the Ministry of Health[25]. There are also centres of

[22] http://www.tubitak.gov.tr/;jsessionid=91797F281C029B3416862594E81332CB?ot=2&sid=993
[23] http://www.tagem.gov.tr/eng/anasayfa.htm
[24] http://www.taek.gov.tr/eng/
[25] http://www.rshm.gov.tr/en/

expertise and centres of excellence at universities and public research organisations established with the support of DPT.

As for the knowledge production by the business sector, with the help of the R&D tax incentives, research-intensive companies and multinationals located in Turkey have established their research centres.

Turkey ranks the 17th in the world in the total number of scientific publications in 2010. While, scientific publications per million populations are below the OECD average, the rate of increase between 2003-2009 is 87%, which is one of the highest in OECD countries. In science citation, the rate of increase in the same period reached approximately 105% from 63,000 in 2003 to 129,000 in 2009 (BTYK22, 2010).

The national patent applications to the TPE increased remarkably from 490 in 2003 and to 2588 in 2009. PCT patent applications have also increased in the same period from 112 in 2003 to 389 in 2009. Increasing the number of triadic patents is one of the objectives of the Turkish S&T policy. It was increased from 8 in 2003 to 18 in 2008.

2.4.2 Policy aiming at improving the quality and excellence of knowledge production

The systems for effective monitoring and review to improve the quality and excellence of knowledge production are not sufficiently developed. There is a need to design and make full use of output indicators and techniques such as international benchmarking and evaluation on the basis of international criteria. The processes for project selection include the use of external peer review and consideration of a set of criteria which are mainly based on the quality of proposals. The private and public sectors and academia are stimulated to take part in international programmes, such as EUREKA and FP7, through various incentives provided mainly by TUBITAK.

2.5 Knowledge circulation

Tackling the challenges that European society faces in the 21st century will require a multi-disciplinary approach and coordinated efforts. Many debates and conferences, e.g. the Lund Declaration recognise that such complex issues cannot be solved by single institutions, technology sectors or MS acting alone. Hence strong interactions within the "knowledge triangle" (education, research and innovation) should be promoted at all levels. Moreover, in the context of increasing globalisation, cross-border flows of knowledge are becoming increasingly important. This section provides an assessment of the actions at national level aiming to allow an efficient flow of knowledge between different R&D actors and across borders.

2.5.1 Knowledge circulation between the universities, PROs and business sectors

Public–private collaboration for R&D is mainly stimulated in technoparks. However, there are no direct financial incentives involved in the system for this purpose (see Section 2.2.2). Also, the MoIT implements the 'Industrial Thesis Projects Programme' to foster research-business collaboration. The share of the funding allocated for this programme in 2009-2010 (€13m, TL24.76m) was low compared to the total R&D funding by the government in the same period (€1,276m, TL2,680m). As of May

2010, 43 universities in 25 provinces in Turkey initiated collaborative projects under this programme with firms from 27 industrial sectors in 65 different technology fields. 37 projects were successfully completed and resulted in innovative products and processes[26].

The other measure for stimulating such collaborations is the 'Support Programme for the Initiative to Build Scientific and Technological Cooperation Networks and Platforms (ISBAP)' of TUBITAK. The scale of ISBAP in total R&D funding of TUBITAK is low (€2.2m, TL4.6m for ten ongoing projects). The 'Support Programme for Public Institutions' Research Projects of TUBITAK also promotes collaboration between universities, PROs and business sectors, although it is not mandatory.

2.5.2 Cross-border knowledge circulation

In the new S&T and innovation strategy document covering period 2011-16, it is stated that a study will be conducted to identify the priority countries for international collaboration by analysing their R&D and innovation capacities and capabilities.

TUBITAK signed 24 bilateral co-operation agreements on research. The EU Member States with which Turkey have bilateral research agreements include the following: Bulgaria, Germany, France, Greece, Hungary, Italy, Romania, Slovakia and Slovenia. Turkey has also signed co-operation agreements with Belarus, India, South Korea, Macedonia, Mongolia, Pakistan, China, Russian Federation, Syria, Tunisia and Ukraine. In addition, Turkey signed a bilateral research protocol with Albania and issued a 'Joint Declaration on Scientific and Technological Co-operation' with India. In 2010, actions were taken to sign research co-operation agreements with the USA, Azerbaijan, Brazil, Czech Republic, Georgia, Poland and Turkmenistan.

Under the 'International Industrial R&D Projects Support Programme', TUBITAK funds the Turkish partners in EUREKA projects (along with other international programmes). Total amount of funds allocated to the projects supported by this programme is approximately €3.02m (TL6.22m) by April 2010 since 2008.

Turkey takes part in ERA-NETs under the Specific Programme "Cooperation", Specific Programme "Capacities" and under FP6. In addition, Turkish representatives participate at the meetings of the Networked and Electronic Media (NEM) and European Construction Technology Platform (ECTP). Turkey is also represented in the Innovative Medicines Initiative (IMI), Nanoelectronics Technologies 2020 (ENIAC) and Fuel Cells and Hydrogen (FCH) Joint Technology Initiatives of the EU through the Turkish universities and TUBITAK.

Inward mobility programmes encourage both foreign researchers and Turkish scientists working abroad. TUBITAK launched a programme 2010 to encourage the brain gain. Under this programme, scholarships are provided (€1,341, TL2,750/month for 2 years) to the Turkish researchers who finalised his/her PhD studies and worked 2 years abroad at a job related to his/her area of expertise.

Turkey actively participates in international, mainly EU, mobility programmes and networks (such as Marie Curie and EURAXESS).

[26] http://sagm.sanayi.gov.tr/DocumentList.aspx?catID=245&lng=tr

2.5.3 Main societal challenges

As noted before, the support mechanisms tend to be generic in nature and a majority of them do not focus on thematic issues. Defence, space and nuclear technologies are the only fields supported through thematic measures. Although favoured, collaborations are not mandatory in these programmes. While there are not any programmes designed yet, energy, water and food have been identified by the BTYK in 2010 as the areas to increase R&D investments (see Section 2.3).

2.6 *Overall assessment*

Increased political commitment in research, higher level of funds allocated by the government, and the existence of a well-developed research system in Turkey are the main opportunities both for resource mobilisation and knowledge production. These two routes are also the areas primarily focused by the policy mix in Turkey. They aim to address two key weaknesses: the low levels of R&D investments and the scarcity of human resources for research. However, there are various risks involved in the system. An important risk may be that since, in particular, programme design practices do not always follow evidence-based and participatory approaches, they may fail to address the actual needs of the research community and the business sector. In addition, the relatively low levels of absorptive capacity of the private sector (particularly that of micro and small enterprises) may hinder the effective use of public finance as well as international funding available through programmes, such as the FPs.

From the knowledge demand side, the main barriers include the limited number of measures to help identify and address knowledge demand by the private and public sectors, and the limited number of mechanisms for systematic monitoring of demand to feed into the policy. The most important programme that has direct impact on identifying demand is the 'Support Programme for the Initiative to Build Scientific and Technological Cooperation Networks and Platforms'. The measure has not yet been adequately taken up by the target groups since it is a relatively new scheme and requires a cultural change on sustainable partnerships between the stakeholders of the research system. The later is also an important weakness which risks effective knowledge circulation at national and international levels.

Table 1: Summary of main policy related opportunities and risks

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• Increased funds for R&D. • Political commitment for investing in knowledge intensive sectors. • Well developed research system.	• The risk of failing to address the actual needs of the research community and the business sector as programme design practices does not always follow participatory approaches. • Need to develop absorptive capacity of the business sector, particularly that of micro and small enterprises. • Generic policy actions towards increasing R&D input without sectoral and regional focus. • Need to conduct systematic evaluations.

Domain	Main policy opportunities	Main policy-related risks
Knowledge demand	• Creation of sectoral platforms. • Existence of a measure to support R&D projects to develop new products and processes for meeting the needs of public organisations.	• Need to enhance evidence-based policy-making practices may block the efforts towards identifying and addressing knowledge demand. • Need for systematic monitoring of demand.
Knowledge production	• Cooperation with the international community especially the EU. • Increase of national funding.	• Need to improve coordination among the different institutions which runs different programmes. • Need to invest in building capacities in the research community and the business sector to benefit from the programmes.
Knowledge circulation	• Increased interest by the business sector to benefit from the increased amounts of R&D funding. • Increase in the number of intermediaries facilitating the cooperation between university and industry.	• Need to improve regulatory framework for universities to encourage collaboration with the business sector and facilitate spin-off formation. • Need to create sustainable professional institutions to facilitate research commercialisation. • Need to increase capacities of intermediaries assisting university-industry cooperation.

The majority of the schemes in the policy mix promote private investments in R&D. While they are effective in rising R&D spending in the business sector, programmes with more favourable conditions specifically targeting micro to small enterprises would be useful to increase the number of companies investing in R&D. In addition, capacity building schemes as well as mentoring and consultancy assistance will be helpful to develop absorptive capacity of the business sector.

Table 2: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Low level of research and innovation culture and investment, particularly in the business sector	• Increased amounts of public funding are available. • Low levels of R&D awareness and capabilities in the micro and small enterprises are not directly addressed by the policy mix. • R&D funding is provided without sectoral and regional focus and this could lead to inefficient use of the R&D funding. • There is a need to conduct systematic evaluation for all R&D programmes and policies.
Low levels of BERD over GERD ratio	• Increase in public funding for business R&D is higher than academic and public R&D. • Limited R&D capabilities and absorptive capacities in the private sector, particularly in micro and small enterprises, can risk the increase in the BERD. • Further streamlining of processes in current programmes can increase the number of applicants from micro and small enterprise sector. • Need to develop R&D capabilities and raise awareness on R&D and innovation in business sector.

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Limited number of human resources for R&D	• The target for increasing the number of FTE researchers is set and measures initiated to reach the target. • Policy mix does not directly address the development of human capital for R&D and innovation at the private sector. • Policy mix needs to target increasing the enrolment and attainment levels in tertiary education, and attracting Turkish PhD students abroad as well as foreign researchers to the country.
Low level of cooperation among different research actors, particularly between universities and the private sector	• Several measures are implemented to stimulate collaboration between universities and the private sector as well as between public organisations and research performers. • Intensified collaboration can be achieved if policy mix also addresses improvements in the regulatory framework for encouraging interactions between universities and the private sector.

3 Interactions between national policies and the European Research Area

3.1 Towards a European labour market for researchers

The Communication Better careers and more mobility: A European Partnership for Researchers proposed by EC in May 2008 aims to accelerate progress in four key areas:

- Open recruitment and portability of grants;
- Meeting the social security and supplementary pension needs of mobile researchers;
- Providing attractive employment and working conditions;
- Enhancing the training, skills and experience of researchers

The Commission has also launched concrete initiatives, such as dedicated information services for researchers, in particular through the activities grouped under the name of EURAXESS – Researchers in Motion. Based on the assessment of the national situation in the four key dimensions detailed above, this section will conclude if national policy efforts are supporting a balanced 'brain circulation', with outward mobility levels matching inward mobility levels. High levels of outward mobility coupled with low levels of inward mobility often signal an unattractive national labour market for researchers and unsuitable research infrastructures. This may trigger, despite the policy efforts supporting the mobility the 'brain drain' rather than brain circulation.

3.1.1 Stocks and mobility flows of researchers

According to TURKSTAT (2008) population statistics, 0.1% of Turkish population has PhD degrees, 0.4% holds masters degrees and 5.9% holds university degrees including the vocational high schools. As noted before, the number of R&D personnel increases with the increase in public funding. When the educational levels of FTE R&D personnel is considered, 23.7% of them holds a PhD or a higher degree, 18.8% holds a masters degree, and 39% holds a bachelors degree (TURKSTAT, 2009). The rest has either a post-secondary non-tertiary or a lower degree. While the holders of a PhD or a higher degree constitute almost half of the FTE R&D personnel employed in the higher education institutes, in the private sector, they make up for only 3% of the total R&D workforce.

According to the 'Careers of Doctorate Holders Survey' of TURKSTAT, employment rate of doctorate holders was 93% in 2009. The unemployment rate was 0.9% and the rate of inactive PhD holders was 6% in the same year. The highest share of PhD holders were employed by the higher education sector (72.7%) which is followed by the government sector (14.9%) and business sector (11.5%). According to the same survey, 14% of PhD holders stayed or lived abroad for more than three months between January 2000 and December 2009. The most important reason for moving out was academic factors (33.1%). This was followed by family or personnel reasons (18.3%) and completion of advanced research qualifications (14.7%). The proportion

of mobility intention of PhD holders within 12 months was 16.2%. The most important reason for this was academic factors (82.2%).

The number of support measures to stimulate inward and outward mobility has increased in the last decade. These measures are mainly implemented by the TUBITAK. Inward mobility programmes encourage both foreign researchers and Turkish scientists working abroad. The EU mobility programmes and networks (such as Marie Curie and EURAXESS) are also effectively used by Turkey.

3.1.2 Providing attractive employment and working conditions

Tax incentives for R&D personnel working in technoparks and in 'R&D Centres', and other incentives like 30% bonus support provided by TUBITAK for the employment of PhD holders in its support programme for industrial R&D are important for increasing the attractiveness of researcher employment. As for the remuneration policies, salaries of academic staff at the public universities cannot be determined by universities and research institutes, while private universities are free in this respect. Average total annual salary of researchers in Turkey in terms of Purchasing Power Standard (PPS) was €26,250 (TL52,800) in 2006 (European Commission, 2007)[27]. This is almost half the EU-25 average of €40,126. In 2007, women researchers constituted 30.7% of total researchers, while the EU-27 average was 28% in the same year. According to the TURKSTAT (2009), the share of women researchers (full-time equivalent) is 26% in the business sector, 8% in the public sector and 66% in the higher education sector. The difference in salaries between men and women researchers was calculated to be around 28% in favour of male researchers (European Commission, 2007). Turkey is relatively well situated in Europe with respect to female employment in research area. National regulations and laws allow the restoration back to the same type of work after career breaks (i.e. maternal leave). Additionally, every university with over a certain number of employments should establish a day care in their premises, which also encourages females to work as researchers.

There is no evidence about the uptake of the European Charter for Researchers in Turkey, which sets the general principles and requirements that enable the frame for successful research performance, knowledge dissemination and technological development, and to the career development of researchers.

3.1.3 Open recruitment and portability of grants

In Turkey, academic positions are regulated by national legislation. In order to improve the conditions for non-national academic staff and researchers, an International Researcher Committee was established according to the decision taken at the BTYK meeting on 24 December 2008. The committee remained operational until the BTYK meeting of 15 December 2009. The aim of the committee is to find solutions to the problems of international researchers in Turkey. Main issues of international researchers to be addressed by the committee are identified as follows:

- Lowering bureaucratic burden for obtaining and renewal of work permission for international researchers and their spouses;
- Solving problems regarding researchers' diploma equivalence and academic promotion;

[27] http://www.eui.eu/Documents/MWP/AcademicCareers/SalaryComparisonEUreport2007.pdf

- Improving education conditions of their children;
- Solving problems regarding social security and health insurance of international researchers to make sure that they can transfer their social security rights to Turkey without any problems, and that they can equally benefit from quality and safe health services accessible to the Turkish citizens.

The committee developed solutions for these problems and identified responsible organisations for executing action points for improvement. Those issues identified by the committee but not yet have been addressed were transferred to the 'Science and Technology Human Resources Coordination Committee', which was established in 2009.

In 2010, TUBITAK created the 'Advisory Board for Science and Technology Human Resources Strategy' to prepare the strategy and action plan for the development of S&T human resources. Based on the studies of the advisory board, the following decisions were taken by the BTYK in June 2010 in order to make sure that Turkey becomes a centre of attraction for S&T human resources:

- Housing opportunities are to be increased for graduate students and young scientists;
- The university revolving fund regulations are to be revised for increasing university-private sector collaboration (revolving fund regulation is known to be a major obstacle for university-firm collaboration since a large portion of the payment for the services of university researchers needs to be paid to the host university);
- The definitions for post-doc researcher and positions are to be made, and necessary legislative, financial and administrative regulations are developed jointly by the Ministry of Finance, the Higher Education Council and TUBITAK.

In February 2011, the Law No. 6111 was issued to provide academic amnesty for undergraduate and graduate students including PhD candidates. The academic amnesty allows students to restore their academic standing at their university departments.

Non-nationals are eligible for permanent research and academic positions. As a member of EURAXESS research vacancies in Turkey are advertised on the European Researcher's Mobility Portal.

The research grants awarded to researchers are not transferable to other national or foreign institutions.

3.1.4 Meeting the social security and supplementary pension needs of mobile researchers

The social security issues of foreign workers (including the researchers) are governed under the Social Insurance and Universal Health Insurance Law (no. 5510). According to the law, foreign researchers who have a residence permit and resided in Turkey for at least one year can participate in pension and health insurance schemes. As noted above in Section 3.1.3, social security issues were identified as one of the problematic areas to be solved for foreign researchers. The main problem is that if a foreign researcher comes to Turkey from a country with no bilateral and multilateral social security agreement, he/she cannot transfer his/her employee personal rights to Turkey. There are 22 countries with which Turkey signed

such an agreement. Among these countries, an agreement exists with the following EU Member States: Germany, Austria, Belgium, Czech Republic, Denmark, France, the Netherlands, Sweden, Luxembourg and Romania. The solution to this problem proposed by the policy-makers was as follows: If a researcher comes to Turkey from a country with no social security agreement, a new system is to be developed to allow him/her to transfer his/her employee personal rights.[28] There are no tax incentives or specific regulations or additional taxes for foreign researchers.

3.1.5 Enhancing the training, skills and experience of European researchers

TUBA implements the 'Post Doctoral Research Programme' where PhD holders are provided with incentives for further research and training. TUBITAK provides scholarships for post-doctoral studies in Turkey and abroad. Universities can send their researchers to work for other universities for short terms, according to Article 35 of the Higher Education Law (Law No. 2547). To benefit from this opportunity, the Middle East Technical University (METU) initiated a national academic staff development programme where they provide PhD programmes for research assistants of other universities in Turkey. There are other universities implementing similar programmes with the inspiration from METU. Once the programmes are approved, universities receive funding from the MoF every year according to the availability of funds in the state budget. For 2008-2009 period, the total budget allocated for this purpose was €12.8m.

There are joint PhD programmes implemented between various universities in Turkey and abroad. Examples include the joint PhD programme between METU, CNRS and Universite D'Orleans (France), and the one between Kirikkale University and Ankara University in Turkey.

3.2 *Research infrastructures*

Research infrastructures (RIs) are a key instrument in the creation of new knowledge and, by implication, innovation, in bringing together a wide diversity of stakeholders, helping to create a new research environment in which researchers have shared access to scientific facilities. Recently, most EU countries have begun to identify their future national RI needs, budgets and priorities in the so called National Roadmaps for Research Infrastructures. These strategic documents also set out a strategic view on how to guarantee and maintain access to research facilities. Although some countries invest heavily in RIs, none can provide all the required state-of-the-art facilities on a national basis. Several large RIs have already been created in Europe. While optimising the use and development of existing RIs remains important, new infrastructures are needed to respond to the latest research needs and challenges. European Strategic Forum for Research Infrastructures (ESFRI) was established in April 2002 to support a coherent approach to policy-making on RIs in Europe and to act as an incubator for international negotiations on concrete initiatives. This section assesses the research infrastructures national landscape, focusing on the national RI roadmap and national participation in ESFRI.

[28] http://www.tubitak.gov.tr/tubitak_content_files//BTYPD/btyk/20/20btyk_karar.pdf

3.2.1 National Research Infrastructures roadmap

DPT promotes the establishment of research infrastructures under two main headings: thematic advanced research centres and central research laboratories. The former is created by well-established universities to facilitate advanced research activities while the later aims to build infrastructures for research in newly established and developing universities. The fields of activities of these centres include the following: Life sciences, engineering and material sciences, agro-food and veterinary, nanotechnology, ICT, defence and space, energy and environment and nuclear technologies. Research centre investments increased by around 128% from €92.22m (TL166m) in 2006 to €184.39m (TL378m) in 2010. The investment planed in 2011 is €220.98m (TL453m) (BTYK, 2010). The main reason for this remarkable growth is the increase in commitment in S&T, as explained before.

As a part of the European Strategy Forum on Research Infrastructures (ESFRI) related activities, the State Planning Organisation (DPT) is in the process of developing the Research Infrastructures Roadmap for Turkey. In the road mapping study, energy, biomedical, physics, engineering and social sciences are given priority.

3.2.2 National participation in the *ESFRI roadmap*. Updates 2009-2010

Turkey is a member of the ESFRI, and actively participates in the thematic working groups and in the EU Roadmap Working Groups (in the fields of Biological and Medical Sciences, Physical Sciences and Engineering, Environmental Sciences, and Social Sciences and Humanities). In addition, Turkey is a partner in the ESFRI projects such as the 'European Multidisciplinary Seafloor Observatory' and the 'Partnership for Advanced Computing in Europe', and is taking steps to participate in the 'Pan-European infrastructure for clinical trials and biotherapy'. Turkey does not commit funds for the implementation of the ESFRI Infrastructures[29].

3.3 *Strengthening research organisations*

The ERA green paper highlights the importance of excellent research institutions engaged in effective public-private cooperation and partnerships, forming the core of research and innovation 'clusters', mostly specialised in interdisciplinary areas and attracting a critical mass of human and financial resources. The Universities/ research institutions should be embedded in the social and economic life where they are based, while competing and cooperating across Europe and beyond. This section gives an overview of the main features of the national higher education system, assessing its research performance, the level of academic autonomy achieved so far, dominant governing and funding models.

3.3.1 Quality of National Higher Education System

Size and rough composition of the HEI

According to the Eurostat data of 2007, total number of tertiary education graduates was 416,000 with the following distribution by field[30]: 40.2% from social sciences, business and law; 15.1% from teaching and training; 13.2% from engineering,

[29] ftp://ftp.cordis.europa.eu/pub/esfri/docs/esfri_roadmap_update_2008.pdf
[30] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CD-10-220/EN/KS-CD-10-220-EN.PDF

manufacturing and construction; 8% from science, math and computing; 6.3% from humanities and arts; 6% health and welfare; 5.8% from services and 4.3 from agriculture and veterinary.

Total R&D spending of the universities was around €1.59b (TL3.02b) in 2008 that is almost 40% of the total budget of universities in the same year, according to TURKSTAT. The amount of research carried out by universities which is funded by the private sector increased from 19.4% in 2000 to 23.4% in 2007. However for 2008 this amount dropped down to 17.4%.

Mission of HEIs

The Turkish universities mainly focus on two missions: transmission of knowledge (teaching) and generation of new knowledge (research). The 'third mission' (i.e. contribution to local or regional wealth and economic development) is not sufficiently taken up by the HEI sector. This role is partly undertaken through the technoparks established by universities under the 'Law of Technology Development Zones'.

The research grants are accessible to all universities on competitive basis.

Research performance

Traditionally, the older universities with better research infrastructure and human resources (mostly located in Turkey's three major cities of Ankara, Istanbul and Izmir) are stronger in research. With respect to the number of academic research projects proposed by universities to TUBITAK and the amount of financial support allocated by TUBITAK to these projects in 2010 (as of October 2010), the best performing five universities are the Middle East Technical University, Istanbul Technical University, Ege University, Ankara University and Hacettepe University. All of these universities are public universities. In 2010, out of 4,853 project proposals submitted by universities to TUBITAK, 923 were proposed by the best performing five universities. TUBITAK selected 1025 projects (with a total budget of around €64m; TL131m) out of 4,400 proposals. Nearly 30% of all projects supported both in terms of number and amount of funding are those proposed by these five universities. Three out of five best performing universities in research projects (the Middle East Technical University, Hacettepe University and Ankara University) are also among the top five universities in the number of publications in the Science Citation Index (SCI) in 2009.

Turkey has the highest scientific collaboration with the USA. According to the NSF figures of 2008, top five co-publications partners of Turkey are as follows: USA (44.4%), UK (13.9%), Germany (12.4%), Italy (6.9%) and Japan (5.6%).

Almost all universities in Turkey aim to improve their quality in education and research in line with the Bologna Process. Governance reform activities in Turkey have mainly focused on developing the 'Quality Management Standards for HEIs' issued by the YOK. According to the regulation 'Quality Management and Evaluation Principles to be applied in Universities', universities in Turkey should establish a quality management system where an internal evaluation is conducted every year and an external evaluation is carried out every five years.

3.3.2 Academic autonomy

Autonomy

Academic freedom of the academic personnel and the scientific autonomy of the higher education institutions are protected by Turkish Constitution, Article 130. In article 130, universities are defined as autonomous institutions having scientific

freedom. The right of universities and that of academic personnel to freely conduct research and publish the results are protected by this article. This article also states that this right cannot be used against the existence and sovereignty of the State and the unity of the Nation and the State. The private universities enjoy financial and administrative autonomy in addition to academic freedom. The public universities, however, do not have financial and administrative autonomies. The organisational scheme of higher education institutions is defined by law. The public HEIs are subject to the same public finance laws as other public agencies. Hence, indirect governance of the state universities by the government and the lack of administrative and financial autonomy are unavoidable unless a legislative change on these two issues is realised (European Commission, 2006).

Governance

In public universities, the Rector is appointed by the President of the Republic from among candidates holding the academic title of professor, selected by the teaching staff members of the university upon the announcement of the currently serving rector. The Vice-Rectors are appointed by the Rector for a period of five years. Deans are appointed by the Council from among three full professors nominated by the rector, while institute and school directors are directly appointed by the rector. The Department is administered by the Head of the Department. The Head of the Department is appointed for three years from among full-time professors in the Department; if none, from among the associate professors; if none, from among the assistant professors. The appointment is made by the Dean upon the recommendations of the division heads in the case of faculties, in the case of schools of higher education attached to the faculty, by the Dean upon the nomination of the Director, and by the Rector upon the nomination of the Director in schools of higher education attached to the office of the Rector. The Senate consists of the Vice-Rectors, the Deans of each faculty, a professor elected for a term of three years by the respective faculty board and Directors of the Graduate Schools and Schools of Higher Education attached to the office of the Rector. The university administrative board consists of all faculty deans plus three professors elected by the senate. (European Commission, 2006).

3.3.3 Academic funding

Every university has a budget for the salaries and investments needed to fund their regular activities. Total budget of the universities for 2009 was around €3.94b (TL8.78b). According to TURKSTAT, total R&D spending of the universities was around €1.72b (TL3.83b) in 2009 that is almost 44% of the total budget of universities in the same year. For research spending, academics are required to prepare applications for their own projects to apply either to TUBITAK or DPT. Universities also have to allocate a percentage of their revolving funds for R&D projects, which usually does not exceed 5% of their incomes from the revolving funds.

Competitive funding for research projects is made available the Research Support Programmes Directorate (ARDEB) TUBITAK. The competition calls are opened based on the intervals agreed by the Science Board of TUBITAK each year, and the projects are peer reviewed by national evaluators based on the criteria provided by TUBITAK (the selection criteria mainly includes the quality of the research proposed and of the research teams involved). The funds disbursed for the programmes of ARDEB in 2007, 2008 and 2009 were €79m (TL144.4m), €74.2m (TL151.9m), and €63m (TL142.5m), respectively.

Block funding to the universities is not linked to scientific results (i.e. bibliometric indicators, patents, etc.).

3.4 Knowledge transfer

The importance of knowledge dissemination and exploitation in boosting competitiveness and contributing to the effectiveness of public research has been increasingly recognised by EC and EU Member States. Following the publication of the ERA Green Paper in April 2007, the EC Communication "Improving knowledge transfer between research institutions and industry across Europe" was issued, highlighting the importance of the effective knowledge transfer between those who do research, particularly HEIs and PROs, and those who transform it into products and services, namely the industry/SMEs.

Several Member States have taken initiatives to promote and facilitate knowledge transfer (for instance new laws, IPR regimes, guidelines or model contracts) and many others are planning to intensify their efforts in this direction. However, these initiatives are often designed with a national perspective, and fail to address the trans-snational dimension of knowledge transfer. This section will assess the national policy efforts aimed to promote the national and trans-national public-private knowledge transfer.

3.4.1 Intellectual Property Policies

IPR policies mainly focus on increasing the level of awareness towards IPR in Turkey. In order to increase the number of patent applications a support programme is implemented by TUBITAK (the 'Programme to Encourage and Support Patent Applications').

The management of intellectual property in knowledge transfer activities does not yet fully follow the Code of Practice for universities and other PROs.

Although knowledge transfer is promoted in HEIs and PROs there are only a few attempts by a small number of universities to establish knowledge transfer organisations. These initiatives are launched in a bottom-up manner is operated and funded by the universities themselves.

3.4.2 Other policy measures aiming to promote public-private knowledge transfer

Spinoffs

Creation of spinoffs is not directly promoted through support measures. However, the 'Law on Technology Development Zones' indirectly promotes spin-off formation. There are two schemes to support the creation of start-up companies by undergraduate/graduate students and young graduates: 'Technopreneurship Support Programme' of the MoIT, and the 'Support Programme for Technology- and Innovation-focused Entrepreneurship') of TUBITAK. Both programmes support entrepreneurs who are about to graduate from a four-year programme of a university in one-year time, or who are currently enrolled in a masters or doctorate programme, or who received their bachelors, masters or doctorate degrees at the maximum five years prior to the application. The lack of private investment for the creation of start-ups and spinoffs is an issue in Turkey. The venture capital industry is under-developed and business angel networks are almost non-existent (UNESCO, 2010).

Inter-sectoral mobility

There exist no direct mobility schemes allowing S&E students/PhDs/researchers to conduct innovation projects in firms. On the other hand, the 'Industrial Thesis Projects Programme' (San-Tez) of the MoIT promotes university-industry interactions by co-financing research activities conducted by universities under thesis studies for a private sector company.

Promoting research institutions - SME interactions

Research institutions and SME interactions are indirectly promoted through technoparks and other schemes stimulating collaborations between research community and the business sector explained under route 5 in Section 2.2.2.

EU cohesion policy

There are no instruments and their impact identified in relation to the promotion of public-private knowledge transfer.

Involvement of private sector in the governance bodies of HEI and PROs

The private sector is not involved in the governance bodies of public universities while it is possible in private universities. PROs may have such involvements in their advisory boards.

3.5 *Cooperation, coordination and opening up national research programmes within ERA*

The articulation between the R&D Framework Programmes, the Structural Funds and the Competitiveness and Innovation Programme is still underdeveloped in terms of coordination, synergies, efficiency and simplification. The policy fragmentation at EU and national level, and between EU and national policies can hinder the build of critical masses of research excellence, leads to the duplication of efforts, sub-optimal impacts of the different instruments and unnecessary administrative overheads. Differences between research selection procedures and criteria can also be an obstacle to the overall spread of excellence. This section assesses the effectiveness of national policy efforts aiming to improve the coordination of policies and policy instruments across the EU, all part of the drive to create an integrated ERA.

3.5.1 National participation in intergovernmental organisations and schemes

Participation in COST, EUREKA and FP7

Turkey has participated in 495 COST projects since 2003. There are 15 COST project proposals and 15 actions which were officially launched by Turkey. Turkey is an active participant in EUREKA projects. As of November 2010, Turkey participated in 120 projects and ranked the 12th among 39 EUREKA partner countries[31]. Total amount of funds allocated to the projects by TUBITAK is approximately €3.02m (TL6.22m) April 2010 since 2008. In FP7, the number of Turkish partners reached 540 as of December 2010. The total amount of funds received by these partners is €82.4m[32].

National participation in inter-governmental research infrastructures

Activities are being carried out by TUBITAK to establish collaborations with the International Centre for Genetic Engineering and Biotechnology, European Molecular Biology Laboratory and the European Space Agency (ESA). Among these

[31] http://www.bilgicagi.com/Yazilar/3690-eurekada_yeni_firsatlar.aspx

[32] http://www.tubitak.gov.tr/tubitak_content_files//BTYPD/btyk/22/BTYK22_Ek2_AB_7CP_Ulke_Performansi.pdf

institutions, collaborations with the ESA are attached higher priority. Turkey signed the European Molecular Biology Conference in 1993.

The Turkish Atomic Energy Authority (TAEK) has been in charge of coordination of the activities related to CERN, participating in the scientific activities, sponsoring the activities undertaken in Turkey and representing Turkey in CERN since 2006. Currently, 15 national research projects related to CERN experiments are being carried out in various universities with the funds provided by TAEK.

3.5.2 Bi- and multilateral agreements with other ERA countries

There are 24 bilateral co-operation agreements on research as stated in Section 2.5.5. Under the joint project calls in 2010, 71 project proposals were received for the IntenC Programme and 5 projects for BMBF programme with Germany, 20 proposals were received for the joint call with Hungary and 16 proposals were submitted to the call with Slovenia[33].

TUBITAK co-ordinates the following multilateral co-operation activities: COST, ESF, EMBO / EMBC, ESA, ICGEB, ICSU, INTAS, NATO, WAITRO and BSEC[34].

3.5.3 Other instruments of cooperation and coordination between national R&D programmes

Turkey participates in the following ERA-NETs under the Specific Programme "Cooperation": BIODIVERSITY, CAPITA, ECO-INNOVERA, ERA LEARN II, ERA-NET MARTEC II, ERARE-2, EUPHRESCO 2, MANUNET II, TRANSCAN, HIV ERA-NET, COREORGANIC II, ERA-ARD II, CROSSTEXNET, SEAS-ERA, CIR^{2}CLE, RURAGRI, MATERA+, EuroNanoMed, WoodWisdomNet2, MNT-ERA-NET II, ICT-AGRI, EMIDA, ARIMNet, ERACOBUILD. The ERA-NETs that Turkey participates in under the Specific Programme "Capacities" are as follows: CONCERT-Japan, ERAFRICA, COREACH II, E-InfraNet, SEERA-EI, New INDIGO, SEE-ERA.NET PLUS, BS-ERA.NET, ERA.Net RUS, KORANET, CORNET II. Furthermore, Turkey also participates in the following ERA-NETs in FP6: E-RARE, EUPHRESCO, SAFEFOODERA, ETRANET, Urban-net, FORSOCIETY, CORNET.

Turkey takes part in the following programmes of the European Science Foundation: ESF Marine Board, ESF/LESC/EMRC Frontiers of Functional Genomics; ESF/LESC Mediterranean Climate Variability and Predictability (MedCLIVAR); ESF/SCSS Globalizing Europe Economic History Network (GlobalEuronet); ESF/New generation of organic based photovoltaic devices (ORGANISOLAR) and ESF/EURYI.

Co-operation with the EU on research is mainly carried out under the research Framework Programmes of the EU.

3.5.4 Opening up of national R&D programmes

Since Turkey is not an EU Member State, opening up national programmes has not been a policy consideration in the country. However, Turkey is represented by TUBITAK in the High Level Group on Joint Programming under the Scientific and Technical Research Committee (CREST). The 'Implementation Plan for the

33 http://www.tubitak.gov.tr/tubitak_content_files//BTYPD/btyk/22/BTYK22_Gelismelere_Iliskin_Degerlendirmeler.pdf

34 http://www.tubitak.gov.tr/sid/1000/pid/547/index.htm

International Science, Technology and Innovation Strategies (2008-2010)' does not address this issue either, while joint research projects are encouraged within the framework of bilateral S&T cooperation agreements with other countries.

3.6 *International science and technology cooperation*

In 2008, the European Commission proposed the Strategic European Framework for International Science and Technology Cooperation to strengthen science and technology cooperation with non-EU countries. The strategy identifies general principles which should underpin European cooperation with the rest of the world and proposed specific orientations for action to: 1) strengthen the international dimension of ERA through FPs and to foster strategic cooperation with key third countries through geographic and thematic targeting; 2) improve the framework conditions for international cooperation in S&T and for the promotion of European technologies worldwide. Having in view these aspects, the following section analyses how national policy measures reflect the need to strengthen the international cooperation in S&T.

3.6.1 International cooperation

Information on research collaboration is given in Section 2.5.2 above. Turkey is attaching increased attention to intensify international cooperation. In 2010, for example, cooperation agreements were signed with the USA, Greece and Czech Republic and discussions were initiated for agreements with Peru, Mexico, Finland, Morocco, India, South Africa, Kenya, Central African Republic and Poland. There is no information available on the outputs, outcomes and impact of these collaborations.

In 2010, joint calls for proposals were opened with the Ukraine National Academy of Sciences, the Korean National Research Foundation and the Hungary National Research and Technology Office. 20 project proposals were submitted to TUBITAK in the period covered by the call. As of May 2010, total number of ongoing projects supported under bilateral agreements was 338.

3.6.2 Mobility schemes for researchers from third countries

Turkey actively participates in international mobility programmes. For example, in 2010 TUBITAK started to organise a series of workshops on "Destination Turkey: European and National Funding Opportunities for Brain Circulation, R&D Cooperation and Research Career" in cooperation with the European Commission (EC), National Science Foundation (NSF) and Turkish Research and Business Organisations (TURBO) to increase awareness on national mobility schemes for researchers and Marie Curie Actions under FP7 as well as research collaboration between Europe and the USA[35].

TUBITAK implements the 'International Researcher Programme (EVRENA)' where foreign researchers who reside outside of Turkey can participate in national research projects[36].

[35] http://euraxess.tubitak.gov.tr/
[36] http://www.tubitak.gov.tr/home.do?cid=11110&lang=en

4 Conclusions

4.1 *Effectiveness of the knowledge triangle*

In Turkey, there is a high political commitment to increase R&D investments. It is aimed to achieve and R&D intensity of 2% (with 60% funded by the private sector) and increase the number of FTE R&D personnel to 150,000 by 2013. To reach these targets, government finance for R&D has been increasing since 2005 and new policy measures have been put in operation. The Turkish Research Area (TARAL) has been initiated to support and sustain these developments. The TARAL approach supports the efforts put to coordinate policies and policy actions with the knowledge triangle. The R&D and innovation system is coordinated by the BTYK, which is chaired by the Prime Minister. The system covers a wide range of actors from the public and private sectors, academia and non-governmental organisations. The BTYK meets regularly twice a year to assess policy implementation and decide on new policy actions. The new S&T and innovation strategy document covering period 2011-2016 was approved by the BTYK in December 2010.

With the new strategies in place, further improvement of policy coordination across policy levels and policy areas within the knowledge triangle remains as the main challenge.

Funding for research projects of HEIs and PROs are provided on a competitive basis. The systems for effective monitoring and review to improve the quality and excellence of knowledge production are not sufficiently developed. There is a need for the use of techniques such as international benchmarking and evaluation on the basis of international criteria. The project selection processes include a set of criteria which are mainly based on the quality of proposals and the use of external peer review.

The major investment-related policy instruments/policy activities crossing the boundaries between research, innovation and education policies include the establishment of thematic advanced research centres and central research laboratories at universities.

Table 3: Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	A new S&T and innovation strategy document covering period 2011-16 was issued in December 2010.	• Existence of ambitious research policy goals and high level commitment to implement policies. • Existence of higher resources to implement policy actions. • Need to increase interactions between research community and business sector, and stimulate research commercialisation. • Need to conduct systematic monitoring and evaluation.

	Recent policy changes	Assessment of strengths and weaknesses
Innovation policy	A new S&T and innovation strategy document covering period 2011-16 was issued in December 2010.	• Need to develop a balanced policy mix also by focusing on increasing the levels of absorptive capacity of the business sector, particularly that of micro and small enterprises. • Need to increase sectoral and regional focus in policies and policy actions. • Need to conduct systematic monitoring and evaluation.
Education policy	No remarkable recent changes	• Need to balance supply and demand in HRST. • Need to increase the number of S&T graduates. • Need to conduct systematic monitoring and evaluation.
Other policies	No remarkable recent changes	• Need to place innovation at the heart of other policy areas. • Need to conduct systematic monitoring and evaluation.

4.2 *ERA 2020 objectives - a summary*

Table 4: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main national policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• 'Advisory Board for Science and Technology Human Resources Strategy' was established in order to ensure that Turkey becomes a centre of attraction for HRST. • Actions were taken by the 'International Researcher Committee' to address the needs of foreign researchers.	• Need to increase supply for science & engineering matching the market demand. • Need to increase attractiveness of working conditions for researchers and academic staff.
2	Increase public support for research	• The government continues to allocate high resources for R&D.	• Increased levels of public support for R&D. • Need to increase R&D expenditures.
3	Increase European coordination and integration of research funding	• Increased effort to benefit from FP7 funding	• Integration of TARAL with ERA is given high importance. • Active ERA-NET participation.

	ERA objectives	Main national policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
4	Enhance research capacity across Europe	• A new S&T and innovation strategy document covering period 2011-16 aims to create more output from existing research capacity and enhance needs-oriented research capacity.	• Increased political commitment to enhance research capacity. • Need to increase R&D investments.
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• Increased efforts to benefit from existing infrastructures and to establish new ones.	• Increase in the public finance allocated to develop world-class research infrastructures. • Active participation in the ESFRI.
6	Strengthen research institutions, including notably universities	• The new S&T and innovation strategy document aims to strengthen R&D infrastructure and capacities at universities.	• Need to focus on the third mission at universities.
7	Improve framework conditions for private investment in R&D	• The new S&T and innovation strategy document aims to improve IPR enforcement.	• Increased efforts to streamline processes in private sector R&D support programmes. • Need to enrich the policy mix (for example by introducing innovation-oriented procurement).
8	Promote public-private cooperation and knowledge transfer	• The new S&T and innovation strategy document focuses creating mechanisms for technology transfer and collaborative R&D.	• Need to create new structures like knowledge transfer offices in line with the international good practices. • Need to improve the regulations to increase the attractiveness of academia-business collaborations for university researchers.
9	Enhance knowledge circulation across Europe and beyond	• Increased efforts to integrate TARAL with ERA.	• High commitment for the participation in intergovernmental organisations and schemes, mainly at the EU level.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• Increased efforts for enhanced international cooperation in S&T.	• High number of bilateral agreements with third countries. • High level of commitment for increasing international S&T cooperation. • Need to raise awareness and develop capabilities of research community and business sector to take part in international projects.

	ERA objectives	Main national policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• Increased efforts to coordinate research and innovation policies under the new S&T and innovation strategy document.	• Existence high level commitment to implement policies. • Existence of higher resources to implement policy actions. • Need to increase interactions within the knowledge triangle. • Need to conduct systematic monitoring and evaluation.
12	Develop and sustain excellence and overall quality of European research	• The new S&T and innovation strategy document aims to increase the quality of research.	• Positive trends in the performance of the national research system. • Need for the use of techniques such as international benchmarking and evaluation on the basis of international criteria.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	• The new S&T and innovation strategy document focuses on mechanisms for creating and diffusing knowledge.	• Need to enhance evidence-based policy-making practices to identify and address knowledge demand. • Need for systematic monitoring of demand.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• Energy, water and food are determined as the areas to focus by the BTYK and also in the new S&T and innovation strategy document.	• Need to enrich the policy mix with measures addressing societal challenges.
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• The new S&T and innovation strategy document highlights the need for disseminating S&T culture at the society and promoting science and society activities.	• Existence of efforts and policy measures to build mutual trust between science and society. • Need to develop and implement tools to strengthen scientific evidence for policy making.

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List of Abbreviations

BERD	Business Enterprise Research and Development
BTYK	Supreme Council of Science and Technology
DPT	State Planning Organisation
EC	European Commission

EU	European Union
FDI	Foreign Direct Investment
FP	European Framework Programme for Research and Technology Development
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GOVERD	Government Expenditure on R&D
HEI	Higher Education Institution
HERD	Higher Education R&D expenditure
IPR	Intellectual Property Rights
KOSGEB	Small and Medium Industry Development Organisation
MoF	Ministry of Finance
MoIT	Ministry of Industry and Trade
MoNE	Ministry of National Education
OECD	Organisation for Economic Cooperation and Development
PPS	Purchasing Power Standard
PRO	Public Research Organisations
R&D	Research and Development
S&E	Science & Engineering
S&T	Science and Technology
SCI	Science Citation Index
SME	Small and Medium Enterprises
TARAL	Turkish Research Area
TPE	Turkish Patent Institute
TTGV	Technology Development Foundation of Turkey
TUBITAK	Scientific and Technological Research Council of Turkey
TURKSTAT	Turkish Statistical Institute
YOK	Higher Education Council
YPK	High Planning Council