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Research and Innovation performance in

Greece

Country Profile

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Greece

Promoting innovation as a driver of a less-dependent and sustainable economy

Summary: Performance in research and innovation

The indicators in the table below present a synthesis of research and innovation (R&I) performance in Greece. They relate knowledge investment and input to performance and economic output throughout the innovation cycle. They show thematic strengths in key technologies and also the high-tech and medium-tech contribution to the trade balance. The indicator on excellence in science and technology takes into consideration the quality of scientific production as well as technological development. The Innovation Output Indicator covers technological innovation, skills in knowledge-intensive activities, the competitiveness of knowledge-intensive goods and services, and the innovativeness of fast-growing enterprises, focusing on innovation output. The indicator on knowledge-intensity of the economy focuses on the economy's sectoral composition and specialisation and shows the evolution of the weight of knowledge-intensive sectors and products.

Key indicators of research and innovation performance			
R&D intensity		Excellence in S&T¹	
2012: 0.69 %	(EU: 2.07 %; US: 2.79 %)	2012: 27.2	(EU: 47.8; US: 58.1)
2007-2012: +0.6 %	(EU: 2.4 %; US: 1.2 %)	2007-2012: -1.9 %	(EU: +2.9 %; US: -0.2)
Innovation Output Indicator		Knowledge-intensity of the economy²	
2012: 76.3	(EU: 101.6)	2012: 31.6	(EU: 51.2; US: 59.9)
		2007-2012: +0.8 %	(EU: +1.0 %; US: +0.5 %)
Areas of marked S&T specialisations: Food, agriculture and fisheries, security, construction, health, and environment		HT + MT contribution to the trade balance	
		2012: -5.4 %	(EU: 4.23 %; US: 1.02 %)
		2007-2012: n.a.	(EU: +4.8 %; US: -32.3 %)

In 2012, Greek national R&D intensity was 0.69 % of GDP showing a 3.5 % increase compared to the previous year. However, it remains significantly below the EU average of 2.06 % of GDP. Regarding the excellence in science and technology indicator, Greece remains below the EU average as its performance has declined compared to 2007. It has managed to slightly raise its performance in the knowledge-intensity indicator compared to 2007, but remains well below the EU average indicating that there is still room for structural change towards more knowledge-intensive activities. In terms of innovation output, Greece is also below the EU average, which can be partly explained by its poor performance in technological innovation, measured by means of patent applications. In terms of the economy's competitiveness, the consistently negative trade balance relating to high- and medium-tech products implies the necessity to concentrate on innovative products to make the country more self-sustainable and possibly more competitive by increasing exports of cutting-edge products.

Some of the key bottlenecks and challenges for Greece include the lack of an integrated legal framework for research performers (overall the system is dominated by the universities) and the weak articulation of R&I policy with other policies, with particularly weak links in the knowledge-triangle sectors. Moreover, exploitation of research results by the business sector is very limited, with very low patenting activity.

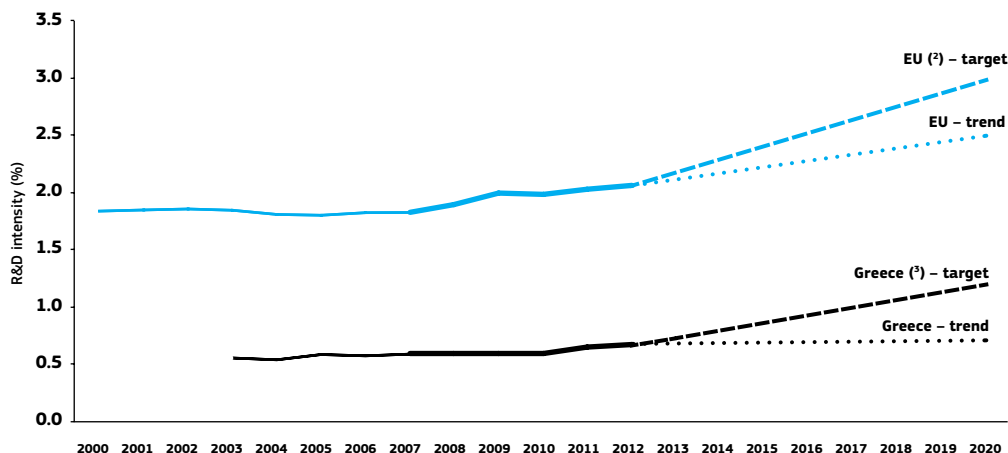
Since 2013, significant actions have been undertaken to reform the Greek R&I system, in order to make it more modern, efficient and adaptable to the country's current economic situation. Indeed, given the current financial situation in Greece, an opportunity has been presented to move towards more knowledge-intensive activities and to concentrate more on high-tech innovative products, which will be identified through the national and regional smart specialisation processes. Such an approach will help decrease the dependency and increase the sustainability of the Greek economy, eventually driving the country out of the economic crisis.

¹ Composite indicator that includes PCT per population, ERC grants per public R&D, top universities and research institutes per GERD and highly cited publications per total publications.

² Composite indicator that includes R&D, skills, sectoral specialization, international specialization and internationalization sub-indicators.

Investing in knowledge

► Greece – R&D intensity projections: 2000–2020 ⁽¹⁾



Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies

Data: DG Research and Innovation, Eurostat, Member State

Notes: ⁽¹⁾ The R&D intensity projections based on trends are derived from the average annual growth in R&D intensity for 2007–2012 in the case of the EU, and for 2001–2007 in the case of Greece.

⁽²⁾ EU: The projection is based on the R&D intensity target of 3.0 % for 2020.

⁽³⁾ EL: The projection is based on a tentative R&D intensity target of 1.21% for 2020.

⁽⁴⁾ EL: There is a break in series between 2011 and the previous years; the values for 2008, 2009 and 2010 were estimated by DG Research and Innovation.

Gross domestic expenditure on R&D (GERD) in Greece was 0.69 % of GDP in 2012, a slight increase compared to the previous year (0.67 %), but still much lower than the EU average of 2.06 % in 2012.

The latest EU2020 R&D target set by Greece in the context of the 2013 European Semester process of 0.67 % of GDP has already been achieved, and the Greek authorities have set a new revised and more ambitious target of 1.21 % of GDP.

In 2012, business expenditure on R&D (BERD) increased to reach 0.24 % of GDP compared to 0.17 % in 2007. This can probably be coupled with Greek participants performing well in the EU Framework Programmes, and shows significant potential nationally in the R&I field, opening up opportunities for the country on the road to recovery.

EU Structural Funds are an important source of funding for R&I activities in Greece. Of the EUR 20.210 million of Structural Funds allocated to Greece over the 2007-2013 programming period,

around EUR 2.020 million (10 % of the total) relate to RTDI³. The 2007-2013 Operational Programme (OP) ‘Competitiveness and Entrepreneurship’ has a total budget of EUR 1.52 billion for which Cohesion policy provides EUR 1.29 billion (EC contribution), representing approximately 6.32 % of the total EU sum invested in Greece under the Cohesion policy (2007-13). It includes Union support for Greek regions that are eligible under the Convergence objective (Eastern Macedonia and Thrace, Thessaly, Epirus, Western Greece, Peloponnese, Ionian Islands, Crete and North Aegean). The OP includes R&I activities mainly in two of its priority axes: ‘Stimulation and development of innovation, supported by research and technological development’ and ‘Improvement of the entrepreneurial environment’. In 2013, the Greek authorities decided to reduce the allocation to the OP’s above-mentioned R&I core priority axes by EUR 67 million, as the result of implementation difficulties and absorption problems.

Greece has been relatively successful in terms of its participation in the Seventh Framework Programme

³ RTDI includes the following sectors: (01) RTD activities in research centres, (02) RTD infrastructures and centres of competence, (03) Technology transfer and improvement of cooperation of networks, (04) Assistance to RTD, particularly in SMEs (and RTD services in research centres), (06) Assistance to SMEs for the promotion of environmentally-friendly products and processes, (07) Investment in firms directly linked to research and innovation, (09) Other methods to stimulate research and innovation and entrepreneurship in SMEs, and (74) Developing human potential in the field of research and innovation.

for Research and Technological Development (FP7). Up until March 2014, 3587 participants from Greece had benefited from FP7, absorbing a total of EUR 974 million with around 15 % of that funding going to Greek small and medium-sized enterprises (SMEs). Despite the fact that Greece ranks 11th in the EU-28 in terms of budget share and ninth in terms of number of participants, success rates in FP7, both in terms of applications and of EU financial contribution, remain relatively low. On the one hand, this shows greater interest from Greek entities in EU funding programmes, while on the other, the potential for raising the level of

excellence in the proposals submitted in an effort to make them more successful and to increase their chances of being retained for EU funding.

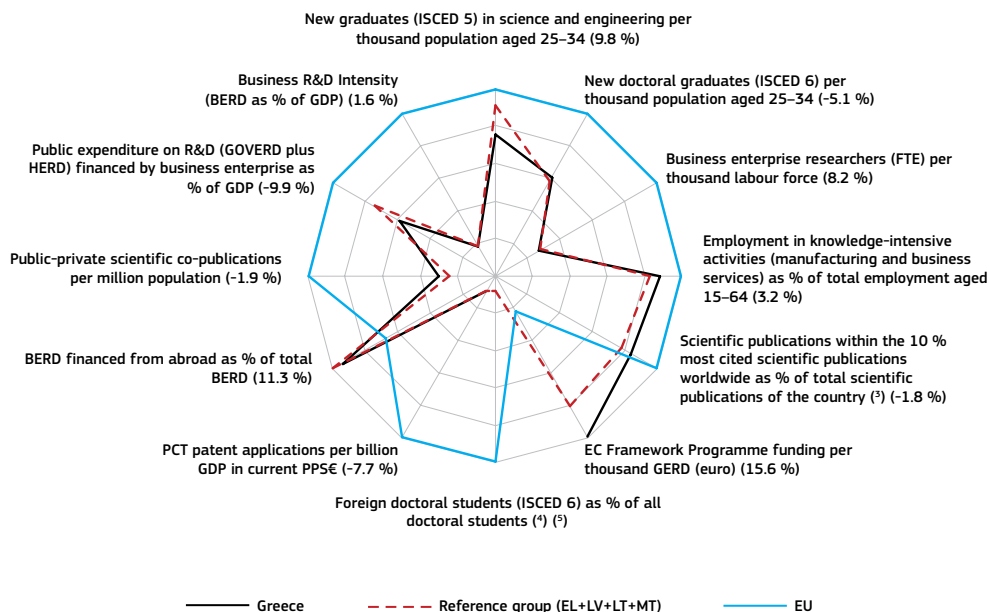
Greece's most active and successful participation in FP7 is in the ICT field, as well as in Marie-Curie actions. The most active Greek entities in FP7 are mainly research organisations and universities – the top-performing entities are the research organisations FORTH and CERTH, both ranked in the top 100 most successful performers in FP7. Greece has most FP7 collaborative links with the Germany, Italy, the United Kingdom, Spain and France.

An effective research and innovation system building on the European Research Area

The graph below illustrates the strengths and weaknesses in the Greek R&I system. Reading clockwise, it provides information on human resources, scientific production, technology valorisation and innovation. Average annual growth rates from 2007 to the latest available year are given in brackets.

► Greece, 2012 ⁽¹⁾

In brackets: average annual growth for Greece, 2007–2012 ⁽²⁾



Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies

Data: DG Research and Innovation, Eurostat, OECD, Science-Matrix/Scopus (Elsevier), Innovation Union Scoreboard.

Notes: ⁽¹⁾ The values refer to 2012 or to the latest available year.

⁽²⁾ Growth rates which do not refer to 2007–2012 refer to growth between the earliest available year and the latest available year for which comparable data are available over the period 2007–2012.

⁽³⁾ Fractional counting method.

⁽⁴⁾ EL is not available and is not included in the reference group.

⁽⁵⁾ EU does not include EL.

The graph above shows that R&D financing in Greece relies significantly more than the EU average on external funding (EC Framework Programme, private R&D funding from abroad); in

particular, since 2007, there has been a significant upward trend for Framework Programme funding. On the other hand, the main challenges for the Greek R&I system lie in human resources with low

levels of business enterprise researchers, foreign doctoral candidates and new doctoral candidates aged 25-34 years, with the latter indicator declining substantially since 2007. Furthermore, Greece is also lagging behind in technological innovation and business investment, with the

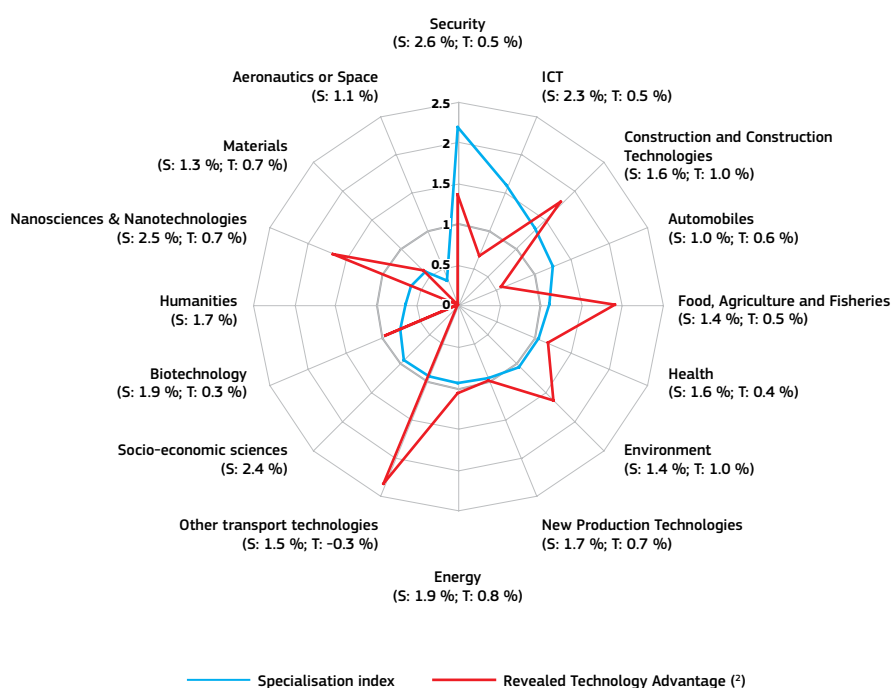
biggest gaps between Greece and the EU average occurring for BERD as % of GDP and PCT patent applications per GDP. These findings underline the conclusion that significant efforts are needed domestically regarding both human capital and technological innovation.

Greece's scientific and technological strengths

The graph below illustrates the areas, based on the Framework Programme thematic priorities, where Greece shows scientific and technological specialisations. Both the specialisation index (SI, based on the number of publications) and the revealed technological advantage (RTA, based on the number of patents) measure the country's scientific (SI) and technological (RTA) capacity compared to that at the world level. For each specialisation field it provides information on the growth rate in the number of publications and patents.

► Greece – S&T National Specialisation ⁽¹⁾ in thematic priorities, 2000–2010

in brackets: growth rate in number of publications ⁽³⁾ (S) and in number of patents ⁽⁴⁾ (T)



Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies

Data: Science-Metrix Canada; Bocconi University, Italy

Notes: ⁽¹⁾ Values over 1 show specialisation; values under 1 show a lack of specialisation.

⁽²⁾ The Revealed Technology Advantage (RTA) is calculated based on the data corresponding to the WIPO-PCT number of patent applications by country of inventors. For the thematic priorities with fewer than 5 patent applications over 2000–2010, the RTA is not taken into account. Patent applications in 'Aeronautics or Space' refer only to 'Aeronautics' data.

⁽³⁾ The growth rate index of the publications (S) refers to the periods 2000–2004 and 2005–2009.

⁽⁴⁾ The growth rate in number of patents (T) refers to the periods 2000–2002 and 2003–2006.

Comparison of the scientific and technological specialisation in selected thematic priorities creates an interesting picture for Greece. In particular, technology production shows a strong specialisation in various fields, namely, other transport technologies, the environment, nanosciences and nanotechnologies, security, construction technologies, and food, agriculture and fisheries. When looking for co-specialisations in both the scientific and technological aspects, there is a match between security, construction and construction technologies, food, agriculture and fisheries, health, and the environment.

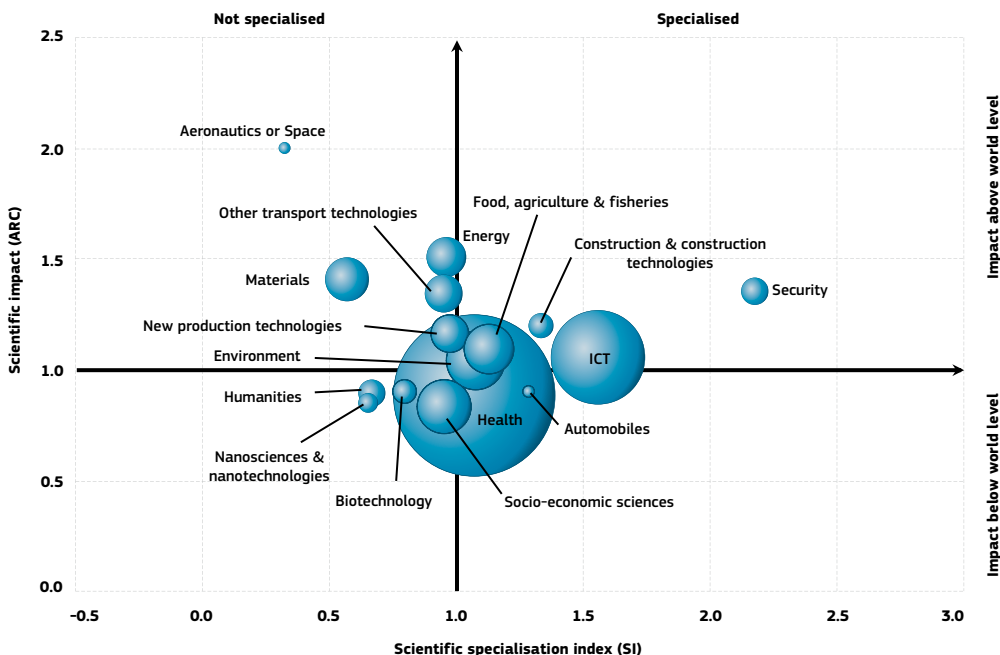
In other transport technologies, where Greece has a very strong technology advantage, it is interesting to note that there is only a marginal advantage in scientific specialisation. Some of the key areas identified in this graph seem to be in line with the key priority areas identified in the Greek national Smart Specialisation Strategy, in which transport and logistics and key enabling technologies have been identified as horizontal priority areas.

The graph below illustrates the positional analysis of Greek publications (specialisation versus impact). It can be seen that in the key area of scientific specialisation, which is the security sector, the impact made is above the world average, which is particularly important for Greece.

Furthermore, it should be highlighted that despite the relatively low levels of scientific specialisation in such areas as energy and materials, these are areas with strong potential impact, which suggests that Greece would probably benefit from concentrating efforts towards the energy technologies and materials sectors.

The graph below illustrates the positional analysis of Greek publications showing the country's situation in terms of scientific specialisation and scientific impact over the period 2000–2010. The scientific production of the country is reflected by the size of bubbles, which corresponds to the share of scientific publications from a science field in the country's total publications.

► Greece – Positional analysis of publications in Scopus (specialisation versus impact), 2000–2010



Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies
 Data: Science-Metrix Canada, based on Scopus
 Note: Scientific specialisation includes 2000–2010 data; the impact is calculated for publications of 2000–2006, citation window 2007–2009.

Policies and reforms for research and innovation

Since the 1990s, Greece has experienced high growth rates exceeding those in many EU Member States and the EU average. However, such rates were not the result of a highly competitive economy. They were mainly driven by internal consumption, so the trade balance remained highly negative indicating a significant disadvantage in competitiveness. In Greece, the financial crisis, which started in 2008, was transformed into a debt crisis in 2009-2010, cutting off access to the international financial markets and leading the economy into recession. The debt and the persistence of the crisis indicated that relying on domestic demand could not be a reliable option for recovery. Since 2010, the economic adjustment programme for Greece has tackled the imbalances accumulated in the pre-crisis years through the stabilisation of public finances and the financial sector and a very comprehensive set of growth-enhancing structural reforms and measures to foster growth by strengthening external competitiveness, stimulating exports and accelerating the reallocation of resources from the non-tradable to the tradable sector.

A combination of structural problems and significant institutional and bureaucratic obstacles, together with a volatile policy environment induced Greek businesses to invest in activities with either high rates of return in the short-term or very low risk. To a large extent, this has shifted economic activity towards less knowledge-intensive and low value-added thematic areas. The sectors with high growth and holding dominant positions are those with relatively low exposure to international competition, such as retail trade, construction, and non-tradable services. At the same time, the share of the primary and manufacturing sectors is shrinking, resulting in a further increase in the trade deficit. The limited exposure to international competition and the privileged access to public-sector procurements have enabled significant segments of the economy to grow without investing in R&D and innovation.

Since 2013, substantial actions have been undertaken by the General Secretariat for Research and Technology (GSRT) regarding the upgrading, modernisation and improvement of the Greek R&I system. In line with policy conditionality under

the adjustment programme and the *ex-ante* conditionalities for the 2014-2020 NSRF, some of the measures announced include the completion of the National Strategy for Research, Technological Development and Innovation 2014-20, the main implementation mechanism of which will be a national Framework Programme for Research and Innovation that will also be linked to the national Smart Specialisation Strategy's identified thematic priority sectors. In addition, more emphasis is expected to be given to research infrastructures with the announced imminent completion of the National Roadmap of Research Infrastructures linked to the European Strategy Forum on Research Infrastructures (ESFRI) process.

Furthermore, other structural measures being announced by the GSRT to improve the national R&I system include evaluation of research centre structures in view of meeting the requirements stemming from the administrative reform of the public sector. In addition, an in depth assessment of research centres is under consideration in terms of excellence and management in order to make them more efficient and align them with the societal challenges and current needs of the Greek economy.

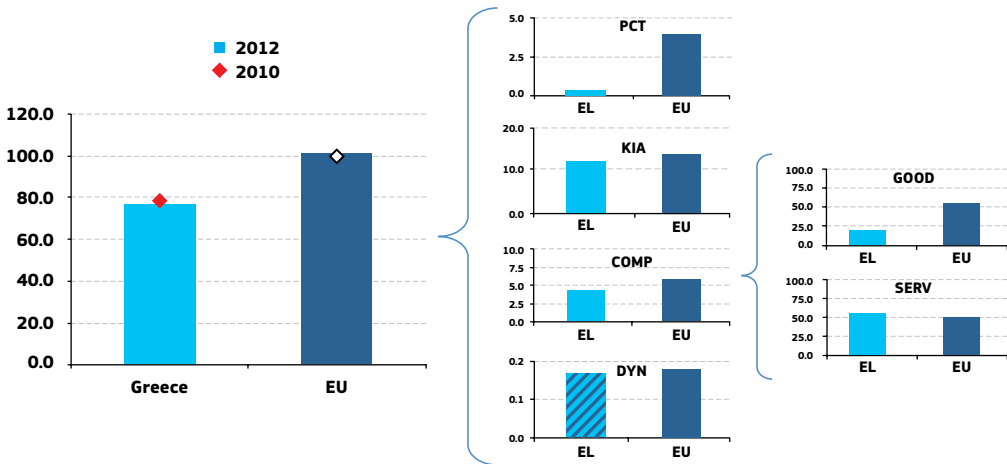
Most of the above-mentioned measures and actions will be implemented within the context of the new institutional framework for research and innovation which is in its final stages of preparation. This new Law for the Development of Research, Technological Development and Innovation, went through a public consultation that was completed at the end of 2013 and was expected to be submitted to the Parliament for adoption in July 2014, as stipulated in the adjustment programme.

In Greece, EU Cohesion funding from the European Structural and Investment Funds (ESIF) is expected to be an important source of funding for R&I activities for the 2014-20 period. As indicated in the draft Partnership Agreement for Greece, around EUR 1.2 billion is expected to be allocated to Thematic Objective 1, 'Strengthening Research, Technological Development and Innovation', which amounts to about 6.5 % of the total Cohesion funding for Greece.

Innovation Output Indicator

The Innovation Output Indicator, launched by the European Commission in 2013, was developed at the request of the European Council to benchmark national innovation policies and to monitor the EU's performance against its main trading partners. It measures the extent to which ideas stemming from innovative sectors are capable of reaching the market, providing better jobs and making Europe more competitive. The indicator focuses on four policy axes: growth via technology – (patents); jobs (knowledge-intensive employment); long-term global competitiveness (trade in mid/high-tech commodities); and future business opportunities (jobs in innovative fast-growing firms). The graph below enables a comprehensive comparison of Greece's position regarding the indicator's different components:

► Greece – Innovation Output Indicator



Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies

Data: Eurostat, OECD, Innovation Union Scoreboard 2014, DG JRC

Notes: All data refer to 2012 except PCT data, which refer to 2010.

PCT = Number of PCT patent applications per billion GDP, PPS.

KIA = Employment in knowledge-intensive activities in business industries as % of total employment.

DYN = Innovativeness of high-growth enterprises (employment-weighted average); estimated value.

COMP = Combination of sub-components GOOD and SERV, using equal weights.

GOOD = High-tech and medium-high-tech products exports as % total exports. EU value refers to EU-28 average (extra-EU = 59.7 %).

SERV = Knowledge-intensive services exports as % of total service exports. EU value refers to EU-28 average (extra-EU = 56 %).

Greece is a low performer in the European innovation indicator. In most components it is performing below the EU average and its performance is not improving.

Employment in knowledge-intensive activities (KIA) is low. However, employment in agriculture, construction and in tourism-related services, not classified as KIA, still plays an important role in the Greek economy.

The relatively low performance in patents is linked to the country's economic structure with a very small capital goods sector and the lack of large manufacturing companies in technology-intensive sectors, which normally show high patenting activities⁴.

Greece exports few capital goods while the export share of agricultural products, mineral fuels and lubricants is high. Hence, its score is low as regards the share of medium-high/high-tech goods in total goods exports. The country performs better in knowledge-intensive services exports, thanks to an important maritime freight transport sector.

⁴ Performance is similar in other IP-related outputs such as trademarks and designs.

Key indicators for Greece

GREECE	2000	2005	2006	2007	2008	2009	2010	2011	2012	Average annual growth 2007–2012 ⁽¹⁾ (%)	EU average ⁽²⁾	Rank within EU
ENABLERS												
Investment in knowledge												
New doctoral graduates (ISCED 6) per thousand population aged 25–34	:	0.74	:	1.44	0.83	:	1.14	1.05	1.11	-5.1	1.81	19
Performance in mathematics of 15-year-old students: mean score (PISA study)	:	:	459	:	:	466	:	:	453	-6.2 ⁽³⁾	495 ⁽⁴⁾	24 ⁽⁴⁾
Business enterprise expenditure on R&D (BERD) as % of GDP	0.15	0.19	0.18	0.17	:	:	:	0.23 ⁽⁵⁾	0.24	1.6	1.31	25
Public expenditure on R&D (GOVERD + HERD) as % of GDP	:	0.40	0.40	0.42	:	:	:	0.43 ⁽⁵⁾	0.45	4.6	0.74	22
Venture capital as % of GDP	0.14	0.004	0.01	0.04	0.10	0.02	0.01	0.004	0.00	-42.3	0.29 ⁽⁶⁾	20 ⁽⁶⁾
S&T excellence and cooperation												
Composite indicator on research excellence	:	:	:	29.9	:	:	:	:	27.2	-1.9	47.8	18
Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country	:	8.9	8.3	9.6	9.5	9.3	:	:	:	-1.8	11.0	15
International scientific co-publications per million population	:	343	405	442	459	516	519	564	590	6.0	343	17
Public-private scientific co-publications per million population	:	:	:	17	16	15	15	16	:	-1.9	53	21
Innovation contributing to international competitiveness												
PCT patent applications per billion GDP in current PPS (EUR)	0.3	0.5	0.4	0.5	0.4	0.4	0.4	:	:	-7.7	3.9	25
License and patent revenues from abroad as % of GDP	0.00	:	0.03	0.02	0.01	0.01	0.02	0.02	0.03	14.0	0.59	24
Community trademark (CTM) applications per million population	15	22	35	43	38	36	34	38	40	-1.1	152	25
Community design (CD) applications per million population	:	1	1	3	2	3	4	4	3	4.0	29	26
Sales of new-to-market and new-to-firm innovations as % of turnover	:	:	25.6	:	:	:	:	:	:	-	14.4	3
Knowledge-intensive services exports as % total service exports	:	:	:	:	55.8	50.6	53.0	:	:	-2.5	45.3	6
Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products	-10.44	-5.39	-5.60	-5.49	-3.80	-5.71	-4.20	-5.69	-5.41	-	4.23 ⁽⁷⁾	28
Growth of total factor productivity (total economy): 2007 = 100	88	96	99	100	98	95	91	88	88	-12 ⁽⁸⁾	97	27
Factors for structural change and addressing societal challenges												
Composite indicator on structural change	:	:	:	30.3	:	:	:	:	31.6	0.8	51.2	27
Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15–64	:	:	:	:	10.8	10.9	10.9	11.4	12.3	3.2	13.9	18
SMEs introducing product or process innovations as % of SMEs	:	:	37.3	:	:	:	:	:	:	-	33.8	13
Environment-related technologies: patent applications to the EPO per billion GDP in current PPS (EUR)	0.04	0.05	0.12	0.04	0.01	0.04	:	:	:	-0.9	0.44	22
Health-related technologies: patent applications to the EPO per billion GDP in current PPS (EUR)	0.07	0.08	0.05	0.13	0.05	0.07	:	:	:	-23.9	0.53	22
EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES												
Employment rate of the population aged 20–64 (%)	61.9	64.6	65.7	66.0	66.5	65.8	64.0	59.9	55.3	-3.5	68.4	28
R&D intensity (GERD as % of GDP)	:	0.60	0.59	0.60	:	:	:	0.67	0.69	0.6 ⁽⁹⁾	2.07	24
Greenhouse gas emissions: 1990 = 100	120	128	125	128	125	118	112	110	:	-18 ⁽¹⁰⁾	83	24 ⁽¹¹⁾
Share of renewable energy in gross final energy consumption (%)	:	7.2	7.4	8.4	8.3	8.5	9.8	11.6	:	8.4	13.0	15
Share of population aged 30–34 who have successfully completed tertiary education (%)	25.4	25.3	26.7	26.2	25.6	26.5	28.4	28.9	30.9	3.4	35.7	18
Share of population aged 18–24 with at most lower secondary education and not in further education or training (%)	18.2	13.6	15.5	14.6	14.8	14.5	13.7	13.1	11.4	-4.8	12.7	17 ⁽¹¹⁾
Share of population at risk of poverty or social exclusion (%)	:	29.4	29.3	28.3	28.1	27.6	27.7	31.0	34.6	4.1	24.8	25 ⁽¹¹⁾

Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies

Data: Eurostat, DG JRC – Ispra, DG ECFIN, OECD, Science Metrix / Scopus (Elsevier), Innovation Union Scoreboard

Notes: ⁽¹⁾ Average annual growth refers to growth between the earliest available year and the latest available year for which compatible data are available over the period 2007–2012.

⁽²⁾ EU average for the latest available year.

⁽³⁾ The value is the difference between 2012 and 2006.

⁽⁴⁾ PISA (Programme for International Student Assessment) score for EU does not include CY and MT. These Member States were not included in the EU ranking.

⁽⁵⁾ Break in series between 2011 and the previous years. Average annual growth refers to 2011–2012.

⁽⁶⁾ Venture capital: EU does not include EE, HR, CY, LV, LT, MT, SI and SK. These Member States were not included in the EU ranking. Average annual growth refers to 2007–2011.

⁽⁷⁾ EU is the weighted average of the values for the Member States.

⁽⁸⁾ The value is the difference between 2012 and 2007.

⁽⁹⁾ Average annual growth refers to 2001–2007.

⁽¹⁰⁾ The value is the difference between 2011 and 2007. A negative value means lower emissions.

⁽¹¹⁾ The values for this indicator were ranked from lowest to highest.

⁽¹²⁾ Values in italics are estimated or provisional.

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