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Research and Innovation performance in EU Member States and Associated countries – Innovation Union progress at country level

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

State of the Innovation Union 2012 - Accelerating change

{COM(2013) 149 final}

Iceland

More innovation for a more competitive economy

Summary: Performance in research, innovation and competitiveness

The indicators in the table below present a synthesis of research, innovation and competitiveness in Iceland. They relate knowledge investment and input to performance or 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 table includes a new index on excellence in science and technology which takes into consideration the quality of scientific production as well as technological development. The indicator on knowledge-intensity of the economy is an index on structural change that focuses on the sectoral composition and specialisation of the economy and shows the evolution of the weight of knowledge-intensive sectors and products and services.

	Investment and Input	Performance/economic output
Research	*R&D intensity* 2009: 3.11% (EU: 2.03%; US: 2.75%) 2000-2011: +1.7% (EU: +0.8%; US: +0.2%)	*Excellence in S&T* 2010: 38.8 (EU:47.86; US: 56.68) 2005-2010: +9.22% (EU: +3.09%;US: +0.53)
Innovation and Structural change	*Index of economic impact of innovation* 2010-2011: 0. 485 (EU: 0.612)	*Knowledge-intensity of the economy* 2010: n.a (EU:48.75; US: 56.25) 2000-2010: n.a. (EU: +0.93%; US: +0.5%)
Competitiveness	*Hot-spots in key technologies* Fishing industries, Industrial machinery, Geothermal energy	*HT + MT contribution to the trade balance* 2011: -13.57% (EU: 4.2%; US: 1.93%) 2000-2011: n.a. (EU: +4.99%; US:-10.75%)

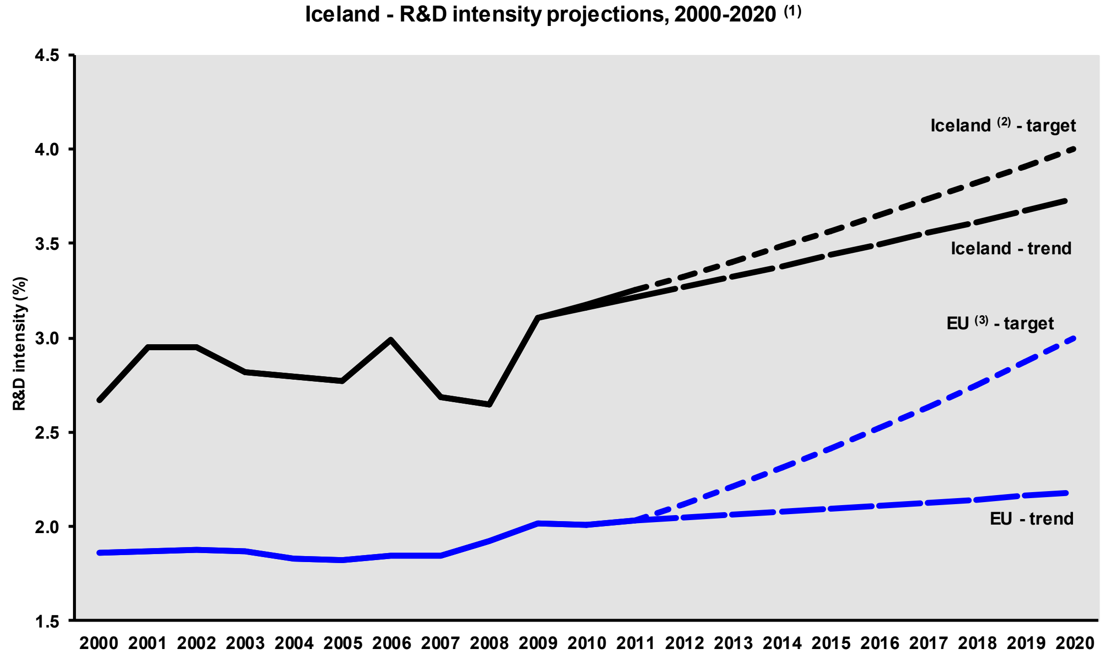
Iceland has one of the highest R&D intensities in Europe and has an excellent science base. However, a main challenge for Iceland is to transform this into economic competitiveness. Evidence shows that Iceland's competitiveness in high-tech and medium-tech products and services is low, with a negative trade balance for high-tech and medium-tech products since 2000. Research and innovation are part of Iceland's recovery package for economic growth. Although there has been less emphasis on major societal challenges following the economic crisis, lifelong learning and the development of adequate skills for the future are two areas that are receiving political attention. A new strategy for R&I for 2010-2012 was presented by the Science and Technology Policy Council (STPC) and a tax reduction scheme was created in 2009 for business R&D projects. Iceland is numbered among the high income countries and has one of the highest levels of early stage entrepreneurial activity.

Current research and innovation policy priorities in Iceland match the structural challenges that the country is facing. The current strategy of the STPC, entitled *Building on Solid Foundations. Science and Technology Policy for Iceland 2010-2012* highlights the following priorities:

- increased focus on innovation and close industry support, on creative industries, and on user-driven innovation;
- more cooperation and synergy among the various universities, research institutions and other actors in the system;
- evaluation and quality control;
- international cooperation and participation in international programmes; and funding on the basis of excellence and thus competition.

This strategy will also address two major weaknesses of the R&I system: the first is the need for increased thematic-oriented funding taking into consideration issues related to the size of the country and critical mass; the second is weaknesses related to governance with an increased emphasis on evaluation as outlined in the STPC strategy for the period 2010-2012.

Investing in knowledge



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat
Notes: (1) The R&D intensity projections based on trends are derived from the average annual growth in R&D intensity for 2000-2011 in the the case of the EU and for 2000-2009 in the case of Iceland.
(2) IS: This projection is based on a tentative R&D intensity target of 4.0% for 2020.
(3) EU: This projection is based on the R&D intensity target of 3.0% for 2020.

Iceland had an R&D intensity of 3.11% in 2009, a relatively high level compared to the EU average of 2.03% (2011). Iceland had already achieved an R&D intensity of 2.95% in 2001. In January 2011, Iceland set an R&D intensity target of 4%, to be reached by 2020, with the private sector contributing 70% of the total and the public sector contributing 30%.

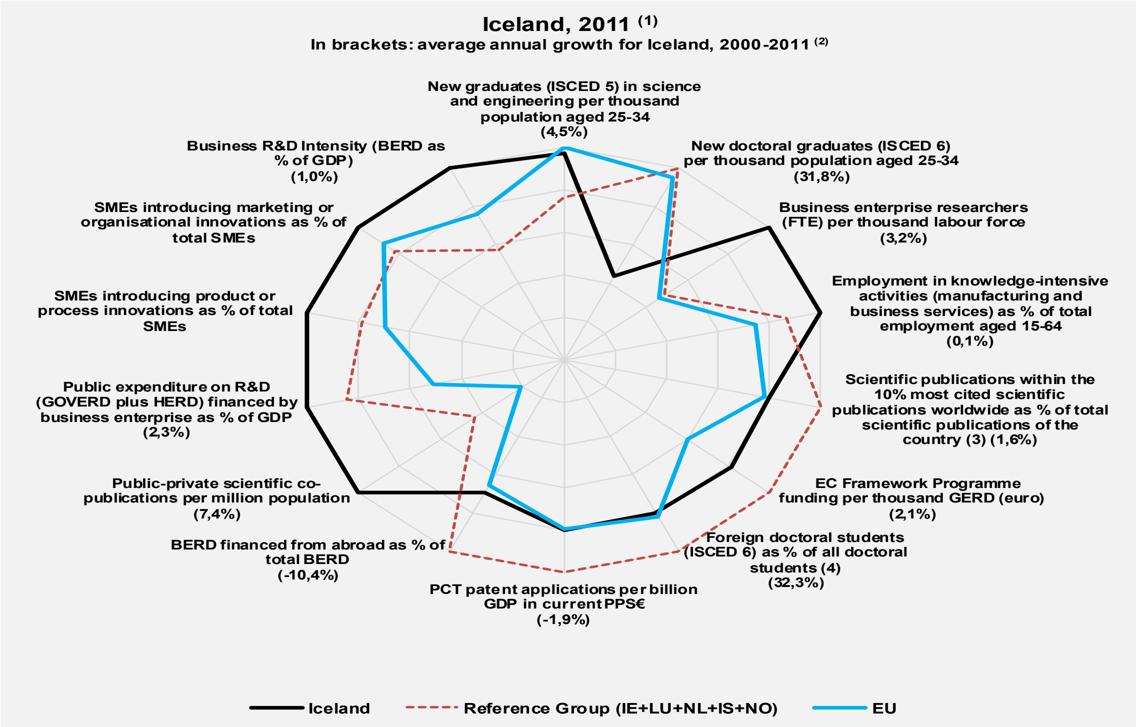
A significant share of total R&D investment in Iceland comes from the public sector. In 2009, the public sector accounted for 44.9% of total R&D investment. The business sector accounted for 52.9%, which shows a decline from 2007 when the share was 54.6%. Insufficient business enterprise expenditure on R&D is one of the key weaknesses of the Icelandic research and innovation system.

In spite of the economic crisis, the government budget for R&D increased by 6.6% between 2011 and 2012. It will be a challenge to maintain this level of increase in public funding for research and development. Mobilising private R&D funding in times of economic crisis is another challenge: the level of private sector funding of R&D in Iceland is considered to be low and has declined since 2007. The government is planning an extra investment of 6,000 billion euros for research and innovation for the period 2013-2015 in the context of the recovery plan.[1]

[1] Investment Plan for Iceland 2013-2015

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

The graph below illustrates the strengths and weaknesses of Iceland's R&I system. Reading clockwise, it provides information on human resources, scientific production, technology valorisation and innovation. Average annual growth rates from 2000 to the latest available year are given in brackets.



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat, OECD, Science Metrix / Scopus (Elsevier), Innovation Union Scoreboard
Notes: (1) The values refer to 2011 or to the latest available year.
(2) Growth rates which do not refer to 2000-2011 refer to growth between the earliest available year and the latest available year for which comparable data are available over the period 2000-2011.
(3) Fractional counting method.
(4) EU does not include DE, IE, EL, LU, NL.; Reference group does not include IE, LU, NL

The main pillar on which political and economic relations between Iceland and the European Union rests, is the European Economic Area (EEA) agreement signed in 1994 which gives Iceland the right to participate in a range of EU programmes in areas such as research and education. The Icelandic Centre for Research (RANNIS) coordinates and promotes Icelandic participation in collaborative international projects in science and technology inside the European Research area. In particular, Iceland places great emphasis on integration in Nordic R&D co-operation programmes, including the Nordic Research and Innovation Area.

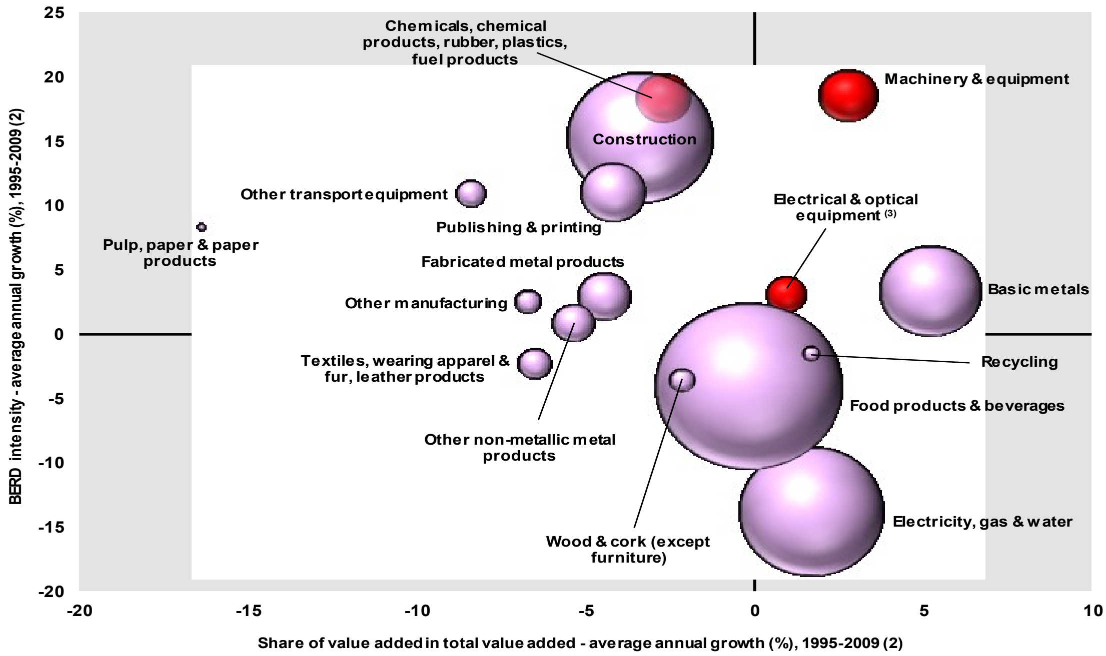
The graph above illustrates that Iceland's strong investment in R&D has triggered high scientific production and very good results in terms of participation in the EC Framework programmes. The economy is very knowledge-intensive as illustrated both by the level of employment in knowledge-intensive activities and the high number of business researchers per thousand labour force. A challenge for Iceland is to increase the numbers of students participating in science, engineering and doctoral studies. There is limited expertise in technology transfer in Iceland. However, recently, there has been an increase in expertise within the field of technology transfer through successful research and development active companies.

The Innovation Centre Iceland (ICI), a government agency, is responsible for delivering support services and providing subsidies for innovation and entrepreneurship related activities. It has the central role of disseminating technology to SMEs and of valorising public investments.

Upgrading the manufacturing sector through research and technologies

The graph below illustrates the upgrading of knowledge in different manufacturing industries. The position on the horizontal axis illustrates the changing weight of each industry sector in value added over the period. The general trend to the left-hand side reflects the decrease of manufacturing in the overall economy. The sectors above the x-axis are sectors whose research intensity has increased over time. The size of the bubble represents the share of the sector (in value added) in manufacturing (for all sectors presented on the graph). The red-coloured sectors are high-tech or medium-high-tech sectors.

Iceland - Share of value added versus BERD intensity - average annual growth, 1995-2009



Source: DG Research and Innovation - Economic Analysis unit
Data: OECD
Notes: (1) High-Tech and Medium-High-Tech sectors are shown in red. 'Chemicals, chemical products, rubber, plastics, fuel products' and 'Other transport equipment' include High-Tech, Medium-High-Tech and Medium-Low-Tech,
(2) 'Electrical and optical equipment': 1997-2009; 'Fabricated metal products': 1998-2009; 'Publishing and printing': 1999-2009.
(3) 'Electrical and optical equipment' includes: 'Electrical machinery and apparatus', 'Radio, TV and communication equipment' and 'Medical, precision and optical instruments'.

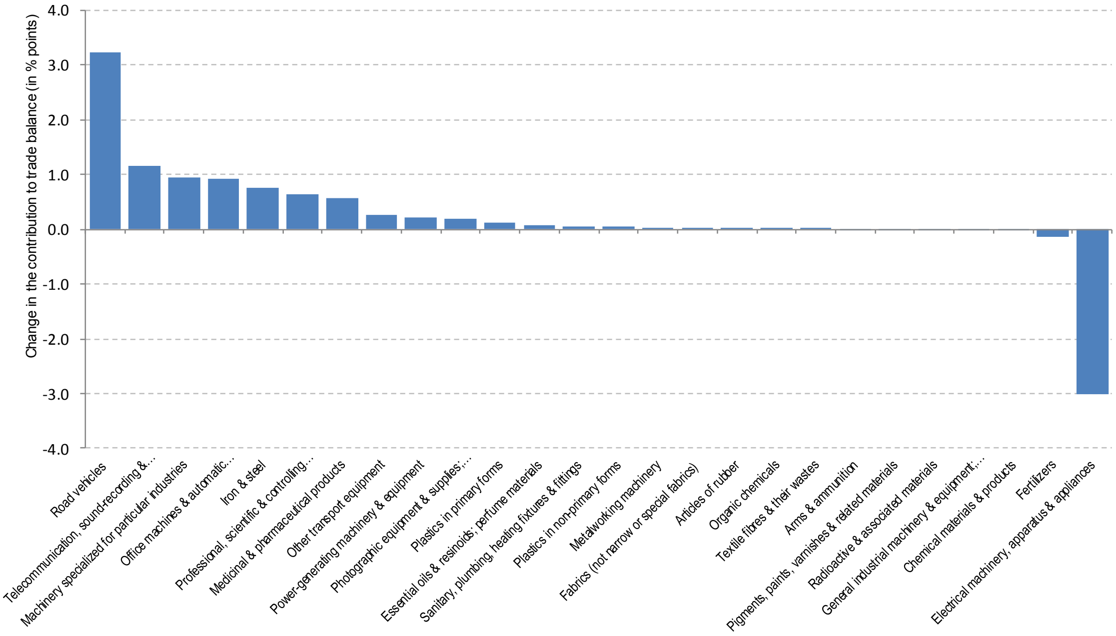
In the last decade, Iceland's economy has been diversifying into manufacturing and service industries, in particular into the fields of software production, biotechnology, and tourism, but the country is still very dependent on the fishing industry (representing 12% of GDP). As a moderate innovator, Iceland has increasing BERD intensities in most of its sectors, as shown on the above graph, with the high-tech and medium-high-tech sectors also gaining in shares of value added.

Iceland has a unique status in terms of energy production: 80% of its electricity needs come from renewable sources, both geothermal and hydropower. This feature has attracted a large amount of foreign investment to the aluminium sector (aluminium production consumes 75% of all electricity generated), and has also attracted the interest of high-tech firms looking to establish data centres using cheap green energy. Pharmaceutical and health industries are considered strategic by the government (even if they only represent 1% of GDP) which wants Iceland to take advantage of its existing knowledge capacity and world level expertise in these domains as reflected by the high number of scientific citations (mostly in molecular biology, genetics, clinical medicine and biology and biochemistry). The Centres of Excellence programme, launched in 2009, aims to stimulate collaboration between industry and academia and is also a means of valorising public R&D investment. Creative industries are an emerging sector, mainly involving SMEs, and are considered to have a very high growth potential.

Competitiveness in global demand and markets

Investment in knowledge, technology-intensive clusters, innovation and the upgrading of the manufacturing sector are determinants of a country's competitiveness in global export markets. A positive contribution of high-tech and medium-tech products to the trade balance is an indication of specialisation and competitiveness in these products.

Evolution of the contribution of high-tech and medium-tech products to the trade balance for Iceland between 2000 and 2011



Source: DG Research and Innovation - Economic Analysis unit
Data: COMTRADE
Notes: "Textile fibres & their wastes" refers only to the following 3-digits sub-divisions: 266 and 267.
"Organic chemicals" refers only to the following 3-digits sub-divisions: 512 and 513.
"Essential oils & resinoids; perfume materials" refers only to the following 3-digits sub-divisions: 553 and 554. "Chemical materials & products" refers only to the following 3-digits sub-divisions: 591, 593, 597 and 598. "Iron & steel" refers only to the following 3-digits sub-divisions: 671, 672 and 679.
"Metalworking machinery" refers only to the following 3-digits sub-divisions: 731, 733 and 737.

Between 2000 and 2007, the total trade balance in Iceland deteriorated rapidly mainly due to increasing levels of imports not being covered by a corresponding growth in exports. This trend has since changed, with a substantial reduction in imports leading to a positive trade balance in 2009. The trade balance deficit was also reflected in a negative trade balance for all high-tech (HT) and medium-tech (MT) products. However, some products performed better than others. The graph above shows the increase of the contribution to the trade balance of several HT and MT products, such as road vehicles, machinery specialised for particular industries, telecommunications and sound recording, other transport equipment, office machines and automatic data-processing machines, medical and pharmaceutical products, and iron and steel. A comparison with the previous graph shows that several industry sectors related to these products have upgraded their R&D intensities over the period 1996-2009. However, few of these sectors have increased their value added.

Total factor productivity is higher in 2012 than in 2000. The employment rate of the population aged 20-64 decreased slightly after 2007, but is still well above the EU average (80.6% against 68.6% in 2011). Iceland is also well positioned, compared to the EU average, regarding societal challenges, with a smaller share of population at risk of poverty and a higher share of population aged 30-34 having completed tertiary education. However, there is a rising level of greenhouse gas emissions and a low and falling level of environmental technologies.

Key indicators for Iceland

ICELAND	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average annual growth [1] (%)	EU average [2]
ENABLERS															
Investment in knowledge															
New doctoral graduates (ISCED 6) per thousand population aged 25-34	0.05	0.07	0.12	0.15	0.24	0.34	0.34	0.22	0.48	0.67	0.77	:	:	31.8	*1.69*
Business enterprise expenditure on R&D (BERD) as % of GDP	*1.50*	1.74	*1.69*	1.46	:	1.43	1.59	1.46	1.44	1.64	:	:		*1.0*	*1.26*
Public expenditure on R&D (GOVERD + HERD) as % of GDP	*1.11*	1.15	*1.20*	1.30	:	1.26	1.32	1.15	1.14	1.40	:	:	:	*2.5*	*0.74*
Venture Capital as % of GDP	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
S&T excellence and cooperation															
Composite indicator of research excellence	:	:	:	:	:	25.0	:	:	:	:	38.8	:	:	9.2	47.9
Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country	9.8	10.3	10.9	11.4	10.4	10.3	11.5	11.7	11.2	:	:	:	:	1.6	10.9
International scientific co-publications per million population	624	656	701	1023	1067	1345	1314	1619	1683	2020	2386	2349	:	12.8	300
Public-private scientific co-publications per million population	:	:	:	:	:	:	:	192	200	216	239	255	:	7.4	53
FIRM ACTIVITIES AND IMPACT															
Innovation contributing to international competitiveness															
PCT patent applications per billion GDP in current PPS€	4.7	4.4	6.5	5.7	4.5	4.6	4.3	3.0	2.7	3.9	:	:	:	-1.9	3.9
License and patent revenues from abroad as % of GDP	:	:	:	:	0.01	:	0.00	0.00	0.00	1.80	1.60	:	:	124.0	0.58
Sales of new to market and new to firm innovations as % of turnover	:	:	:	:	12.7	:	:	:	:	:	6.1	:	:	-11.6	14.4
Knowledge-intensive services exports as % total service exports	:	:	:	:	26.3	20.7	20.6	19.3	19.1	52.9	50.3	:	:	11.4	45.1
Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products	-19.65	-17.96	-17.02	-18.17	-17.51	-16.81	-17.67	-13.22	-12.93	-11.96	-12.83	-13.57	:	-	4,20 [3]
Growth of total factor productivity (total economy) - 2000 = 100	100	101	101	102	108	109	107	107	106	103	100	103	105	5 [4]	103
Factors for structural change and addressing societal challenges															
Composite indicator of structural change	39.8	:	:	:	:	53.3	:	:	:	:	60.6	:	:	4.3	48.7
Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64	:	:	:	:	:	:	:	:	18.2	18.8	18.3	18.2	:	0.1	13.6
SMEs introducing product or process innovations as % of SMEs	:	:	:	:	:	:	:	:	:	:	55.1	:	:	:	38.4
Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€	0.57	0.00	0.00	0.07	0.12	0.00	0.00	0.00	0.00	:	:	:	:	-32.1	0.39
Health-related technologies - patent applications to the EPO per billion GDP in current PPS€	1.65	0.89	2.00	1.21	1.30	2.00	1.62	0.47	0.87	:	:	:	:	-7.7	0.52
EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES															
Employment rate of the population aged 20-64 (%)	:	:	:	85.1	84.4	85.5	86.3	86.7	85.3	80.6	80.4	80.6	:	-0.7	68.6
R&D Intensity (GERD as % of GDP)	2.67	2.95	*2.95*	2.82	:	2.77	2.99	2.68	2.64	3.11	:	:	:	*1.7*	*2.03*
Greenhouse gas emissions - 1990 = 100	110	109	110	109	111	109	124	131	142	134	130	:	:	20 [5]	85
Share of renewable energy in gross final energy consumption (%)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Share of population aged 30-34 who have successfully completed tertiary education (%)	32.6	31.0	33.6	38.2	38.8	41.1	36.4	36.3	38.3	41.7	40.9	44.6	:	2.9	34.6
Share of population at risk of poverty or social exclusion (%)	:	:	:	:	13.7	13.3	12.5	13.0	11.8	11.6	13.7	13.7	:	0.0	*24.2*

Source: DG Research and Innovation - Economic Analysis Unit

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 2000-2012.

(2) EU average for the latest available year.

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

(4) The value is the difference between 2012 and 2000.

(5) The value is the difference between 2010 and 2000. A negative value means lower emissions.

(6) Values in italics are estimated or provisional.

Israel

The challenge of attracting foreign funding for innovation

Summary: Performance in research, innovation and competitiveness

The indicators in the table below present a synthesis of research, innovation and competitiveness in Israel. They relate knowledge investment and input to performance or 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 table includes a new index on excellence in science and technology which takes into consideration the quality of scientific production as well as technological development. The indicator on knowledge-intensity of the economy is an index on structural change that focuses on the sectoral composition and specialisation of the economy and shows the evolution of the weight of knowledge-intensive sectors and products and services.

	Investment and Input	Performance/economic output
Research	*R&D intensity* 2010: 4.40% (EU: 2.03%; US: 2.75%) 2000-2011: +0.31% (EU: +0.8%; US: +0.2%)	*Excellence in S&T* 2010: 77.13 (EU:47.86; US: 56.68) 2005-2010: +2.68% (EU: +3.09%;US: +0.53)
Innovation and Structural change	*Index of economic impact of innovation* 2010-2011: n.a. (EU: 0.612)	*Knowledge-intensity of the economy* 2010: n.a (EU:48.75; US: 56.25) 2000-2010: n.a. (EU: +0.93%; US: +0.5%)
Competitiveness	*Hot-spots in key technologies* ICT, Chemicals, Food products and beverages	*HT + MT contribution to the trade balance* 2011: 5.42% (EU[1]: 4.2%; US: 1.93%) 2000-2011[2]: +8.62% (EU[1]: +4.99%; US:-10.75%)

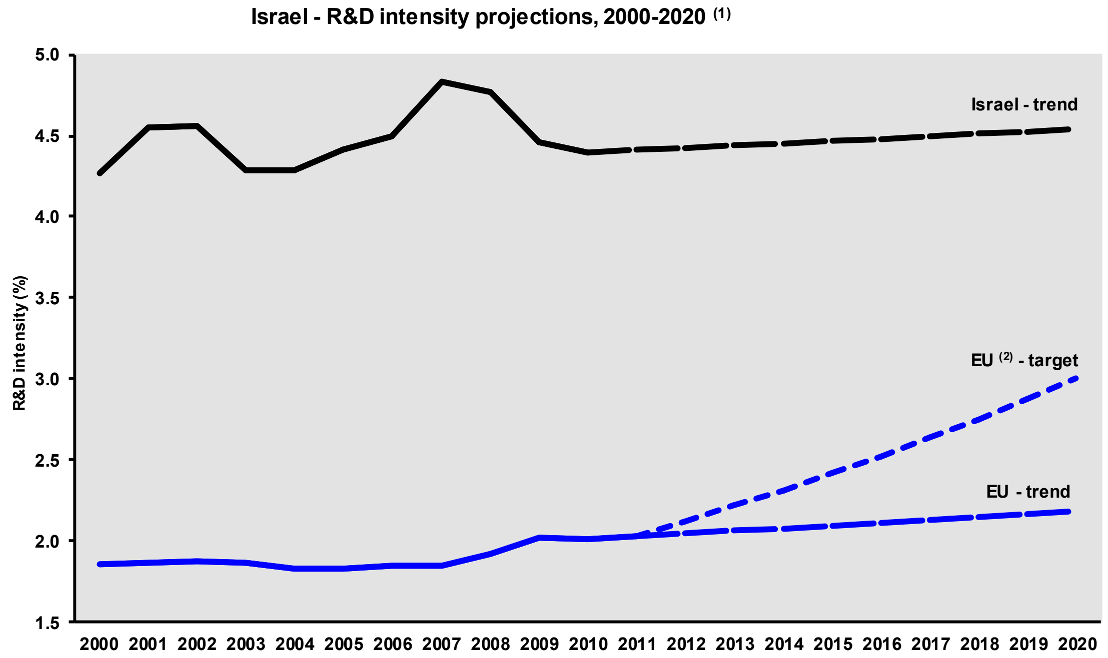
[1] *The EU value is the weighted average of the trade balance of the Member States.*
[2] *The annual growth rate is calculated for the period 2008 - 2010.*

Israel is a very knowledge-intensive country. It has a strong and dynamic business sector and has achieved excellence in scientific and technical education and research. This has led to high levels of technological entrepreneurship and start-ups. The economy is very knowledge-intensive with high-tech and medium-tech products contributing significantly to the trade balance. The main strengths of Israel are its high research intensity, mainly due to a very high business expenditure on R&D, and its patenting activity. The number of business researchers (head count) per thousand labour force is more than four times the EU average (14.8 compared to 3.4, in 2009) and the country has been successful in attracting foreign investment for research and innovation. Israel is ranked second (to the United States) worldwide in terms of venture capital availability, thus ensuring the right conditions for highly innovative small companies across all sectors.

Nevertheless, in spite of this high performance in the field of research and innovation, Israel faces some structural challenges that have created a certain stagnation over the last decade. Budgets for Israeli universities have not increased in line with the growth of student numbers resulting in a decline in scientific production and outward mobility of students. Venture Capital (VC) has fallen due to the low returns on VC investments. As a consequence, the total funds available for investment are at a lower level than in previous years. Israeli fund management firms need to raise new funds if they are to continue their important role in supporting Israeli start-ups.

Recently there has been a reform of the governance of the public R&I system, and a six-year plan to revive higher education and university-based research was launched in 2011. The plan calls for a 30% increase in budgets, a doubling of funding for competitive grants, and a 9% increase in the number of researchers. The plan provides for the creation of twenty new CORE centres of research, four of which are already operational.

Investing in knowledge



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat
Notes: (1) The R&D intensity projections based on trends are derived from the average annual growth in R&D intensity for 2000-2011.
(2) EU: This projection is based on the R&D intensity target of 3.0% for 2020.
(3) IL: An R&D intensity target for 2020 is not available.

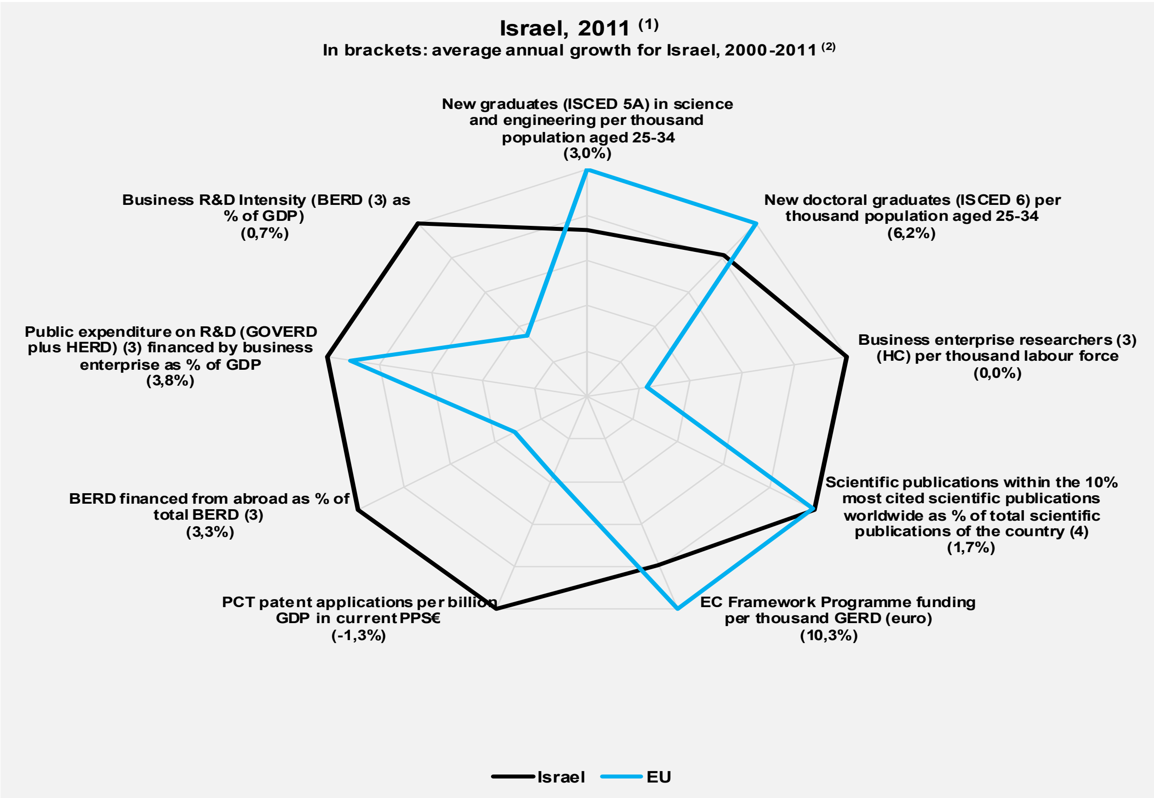
Israel's R&D intensity was already higher than 4% in 2000 and continued to increase until 2007, when it reached 4.84%. It then decreased to 4.40% in 2010 a value which is more than double the EU average. The business sector accounts for around 80% of total R&D expenditure. Although Israel was less affected by the global economic and financial crisis than other countries, business R&D intensity decreased from 3.9% in 2007 to 3.51% in 2010.

Foreign owned firms contribute to increasing the R&D intensity of a country through inward investment in R&D. The level of inward investment in R&D is an indicator both of the degree of internationalisation of business R&D and also of the attractiveness of the country for foreign investors. In 2007 (the latest available year), R&D expenditure of foreign affiliates accounted for 62% of the total R&D expenditure of enterprises. The corresponding shares for Belgium, Austria and Sweden were 59.4%, 53.5% and 33.1%, respectively. In the case of Israel 80% of inward investment in R&D is invested in non-manufacturing sectors.[2]

[2] Internationalisation of business investments in R&D and analysis of their economic impact, Final Report, Study financed by the European Commission, DG RTD, April 2012

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

The graph below illustrates the strengths and weaknesses of Israel's R&I system. Reading clockwise, it provides information on human resources, scientific production, technology valorisation and innovation. Average annual growth rates from 2000 to the latest available year are given in brackets.



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(3) IL: Defence is not included.
(4) Fractional counting method.

The graph shows that Israel is well above the EU average for the majority of the R&I indicators. Indeed, Israel's overall level of innovation performance places it among the group of European "innovation leaders". Only Sweden, Switzerland and Finland show higher levels of innovation performance. PCT patent applications per billion GDP are three times higher than the EU average, a remarkable difference (even if there has been an average annual decrease of 1.43% over the period 2000-2010).

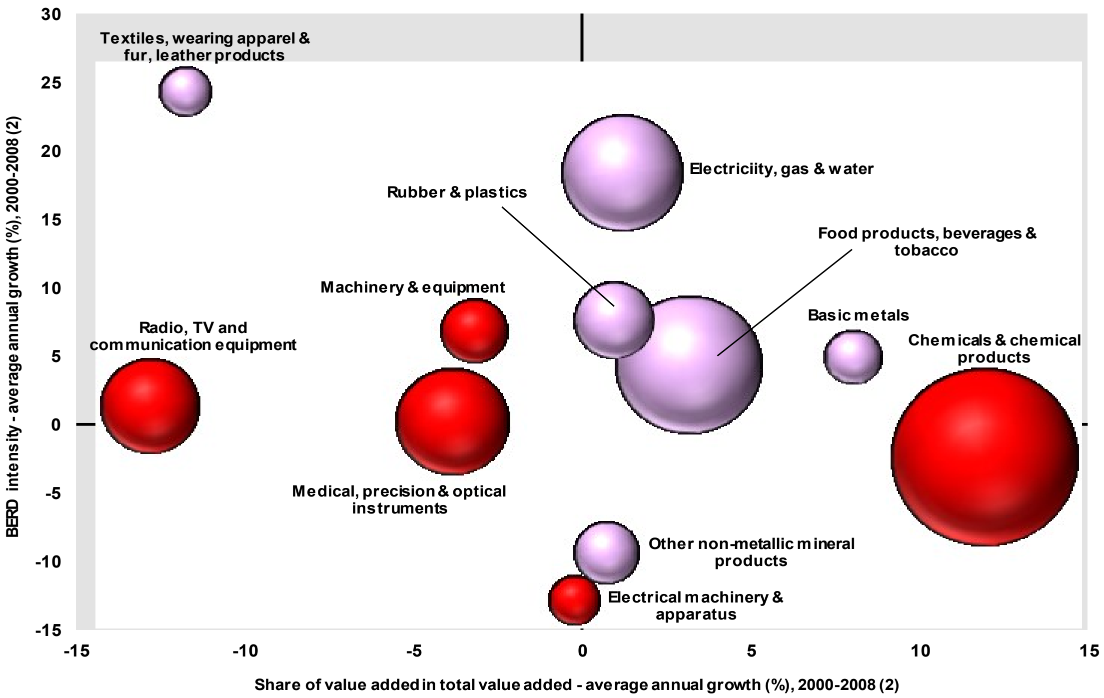
Although the supply of human resources for science and technology is below the EU average for new science and technology graduates and new doctoral graduates per thousand population aged 25-34, knowledge production as evidenced by highly-cited scientific publications is at the same level as the EU average indicating a good scientific base. This is confirmed by Israel's remarkable level of participation as an associated country in the 7th Framework Programme: Israel has four institutions[3] in the top 50 participant HES organisations in signed grant agreements for the period 2007-2010.

[3] HEBREW UNIVERSITY OF JERUSALEM, WEIZMANN INSTITUTE OF SCIENCE, TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY and TEL AVIV UNIVERSITY.

Upgrading the manufacturing sector through research and technologies

The graph below illustrates the upgrading of knowledge in different manufacturing industries. The position on the horizontal axis illustrates the changing weight of each industry sector in value added over the period. The general trend to the left-hand side reflects the decrease of manufacturing in the overall economy. The sectors above the x-axis are sectors whose research intensity has increased over time. The size of the bubble represents the share of the sector (in value added) in manufacturing (for all sectors presented on the graph). The red-coloured sectors are high-tech or medium-high-tech sectors.

Israel - Share of value added versus BERD intensity - average annual growth, 2000-2008



Source: DG Research and Innovation - Economic Analysis unit
Data: OECD
Notes: (1) High-Tech and Medium-High-Tech sectors are shown in red.
(2) 'Medical, precision and optical instruments': 2001-2008.

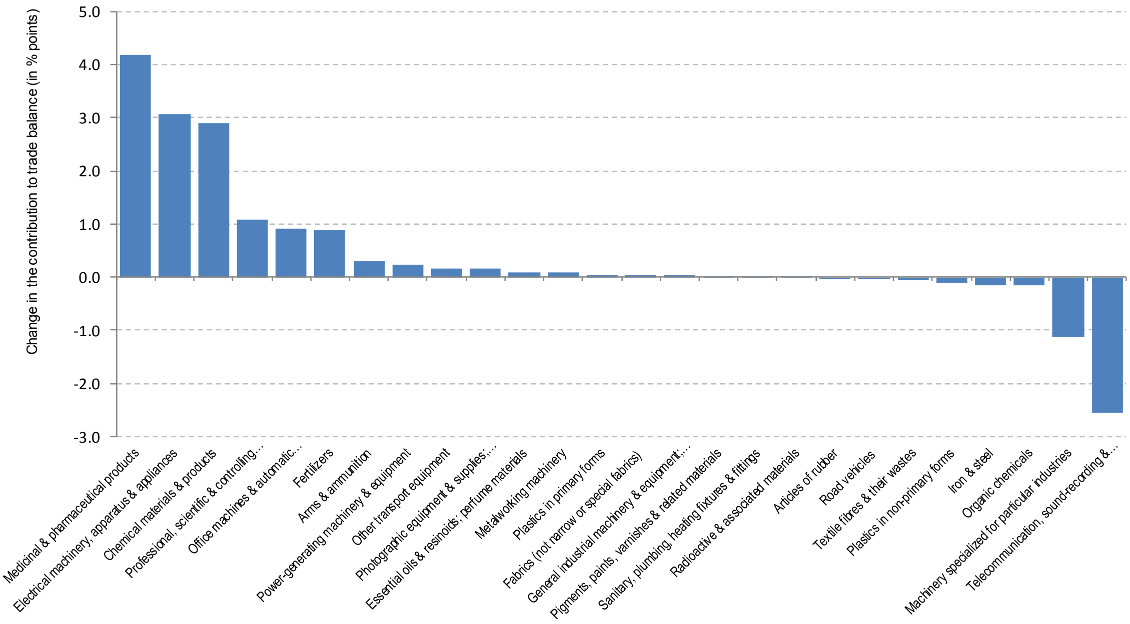
GDP growth is expected to be lower in 2012 than in the previous two years. Industry plays an important role in the Israeli economy and is focused on high technology products. There are a growing number of start-up companies, in particular in the communications, IT and defense sectors. The graph above shows the evolution of value added and business R&D expenditure by manufacturing sectors for the period 2000-2008. While most of the sectors increased their BERD intensities (with the exceptions of other non-metallic mineral products, and electrical machinery and apparatus) a smaller number of sectors reinforced their weights in the economy, by increasing their shares of value-added, most notably in the cases of chemicals and chemical products, basic metals, and food products, beverages and tobacco. On the contrary, high-tech sectors such as machinery and equipment, medical, precision and optical instruments, and radio, TV and communication equipment show declining shares of value added over the same period.

According to the EU Industrial R&D Investment Scoreboard, Israel has been successful in maintaining its position in strategic sectors. In the last five years, the most R&D-intensive Israeli firms have increased their investments in R&D, even during the economic crisis, and have retained their positions among the top R&D investors in sectors such as Pharmaceuticals, Aerospace, Electronics, Semiconductors and Software and General Industrial.

Competitiveness in global demand and markets

Investment in knowledge, technology-intensive clusters, innovation and the upgrading of the manufacturing sector are determinants of a country's competitiveness in global export markets. A positive contribution of high-tech and medium-tech products to the trade balance is an indication of specialisation and competitiveness in these products.

Evolution of the contribution of high-tech and medium-tech products to the trade balance for Israel between 2000 and 2011



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Notes: "Textile fibres & their wastes" refers only to the following 3-digits sub-divisions: 266 and 267.
"Organic chemicals" refers only to the following 3-digits sub-divisions: 512 and 513.
"Essential oils & resinoids; perfume materials" refers only to the following 3-digits sub-divisions: 553 and 554. "Chemical materials & products" refers only to the following 3-digits sub-divisions: 591, 593, 597 and 598. "Iron & steel" refers only to the following 3-digits sub-divisions: 671, 672 and 679.
"Metalworking machinery" refers only to the following 3-digits sub-divisions: 731, 733 and 737.

Between 2000 and 2008 Israel succeeded in reducing its overall trade balance deficit and in 2009 achieved a positive trade balance. This positive outcome is explained by the growing importance of all high-tech (HT) and medium-tech (MT) products, which since 2008 have registered a positive trade balance. In fact, in 2000 the exports of HT plus MT products only covered 70% of the corresponding imports. However, by 2010 this state of affairs had been reversed with exports of HT plus MT commodities now 30% higher than the corresponding imports. As shown on the graph above, the highest growths at sector level, for HT and MT products were in medical and pharmaceutical products, electrical machinery, chemical materials and products, professional scientific and controlling instruments, fertilizers, and office machines and automatic data processing machines.

Israel is investing strongly in environmental-related technologies as shown by a value of 0.47 (compared to an EU average of 0.39) for patent applications to the EPO per billion GDP in 2008 and an average annual growth rate of 13.7% over the period 2000-2008. On the contrary, patent applications for health-related technologies per billion GDP have decreased at an average annual rate of 1% but in 2008 were still at a very high level of 2.61 compared to an EU average of 0.52. Both indicators are evidence of the dynamism of the business sector. The employment rate increased in 2011 to 60.9% but was lower than the EU average of 68.6%.

Key indicators for Israel

ISRAEL	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average annual growth [1] (%)	EU average [2]
ENABLERS															
Investment in knowledge															
New doctoral graduates (ISCED 6) per thousand population aged 25-34	0.75	0.90	0.87	0.99	1.10	1.15	1.14	1.19	1.31	1.23	1.37	:	:	6.2	*1.69*
Business enterprise expenditure on R&D (BERD) [3] as % of GDP	3.28	3.52	3.47	3.19	3.25	3.43	3.51	3.90	3.80	*3.55*	*3.51*	:	:	*0.7*	*1.26*
Public expenditure on R&D (GOVERD + HERD) [4] as % of GDP	0.87	0.91	0.95	0.96	0.89	0.85	0.83	0.79	0.82	*0.77*	*0.75*	:	:	*-1.5*	*0.74*
Venture Capital as % of GDP	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
S&T excellence and cooperation															
Composite indicator of research excellence	:	:	:	:	:	67.6	:	:	:	:	77.1	:	:	2.7	47.9
Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country	9.6	10.7	10.1	10.4	10.8	11.0	11.0	11.0	11.0	:	:	:	:	1.7	10.9
International scientific co-publications per million population	573	513	522	716	751	774	800	828	836	820	860	897	:	4.2	300
Public-private scientific co-publications per million population	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
FIRM ACTIVITIES AND IMPACT															
Innovation contributing to international competitiveness															
PCT patent applications per billion GDP in current PPS€	11.8	11.1	10.2	11.6	12.2	14.0	14.2	13.7	11.3	10.6	:	:	:	-1.3	3.9
License and patent revenues from abroad as % of GDP	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Sales of new to market and new to firm innovations as % of turnover	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Knowledge-intensive services exports as % total service exports	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products	-4.67	-5.40	-5.06	-3.25	-3.55	-3.08	-2.29	-5.06	4.23	6.86	6.48	5.42	:	-	4,20 [5]
Growth of total factor productivity (total economy) - 2000 = 100	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Factors for structural change and addressing societal challenges															
Composite indicator of structural change	51.1	:	:	:	:	55.4	:	:	:	:	63.2	:	:	2.2	48.7
Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
SMEs introducing product or process innovations as % of SMEs	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€	0.17	0.20	0.12	0.23	0.26	0.25	0.32	0.29	0.47	:	:	:	:	13.7	0.39
Health-related technologies - patent applications to the EPO per billion GDP in current PPS€	2.83	2.91	2.92	3.39	3.15	3.71	2.98	2.84	2.61	:	:	:	:	-1.0	0.52
EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES															
Employment rate of the population aged 15-64 (%)	56.1	55.7	54.8	55.0	55.7	56.7	57.6	58.9	59.8	59.2	60.2	60.9	:	0.7	68.6
R&D Intensity (GERD [3] as % of GDP)	4.27	4.55	4.56	4.28	4.29	4.42	4.50	4.84	4.77	4.46	4.40	:	:	*0.3*	*2.03*
Greenhouse gas emissions - 1990 = 100	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Share of renewable energy in gross final energy consumption (%)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Share of population aged 25-34 who have successfully completed tertiary education (%)	:	:	:	:	:	:	:	:	:	42.9	:	:	:	:	34.6
Share of population at risk of poverty or social exclusion (%)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:

Source: DG Research and Innovation - Economic Analysis Unit

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 2000-2012.

(2) EU average for the latest available year.

(3) Defence is not included,

(4) Defence is not included in GOVERD; Social Sciences and Humanities is not included in HERD.

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

(6) Values in italics are estimated or provisional.

Norway

The challenge of structural change for a more knowledge-intensive and sustainable economy

Summary: Performance in research, innovation and competitiveness

The indicators in the table below present a synthesis of research, innovation and competitiveness in Norway. They relate knowledge investment and input to performance or 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 table includes a new index on excellence in science and technology which takes into consideration the quality of scientific production as well as technological development. The indicator on knowledge-intensity of the economy is an index on structural change that focuses on the sectoral composition and specialisation of the economy and shows the evolution of the weight of knowledge-intensive sectors and products and services.

	Investment and Input	Performance/economic output
Research	*R&D intensity* 2011: 1.70% (EU: 2.03%; US: 2.75%) 2000-2011*: +0.66% (EU: +0.8%; US: +0.2%)	*Excellence in S&T* 2010: 51.77 (EU:47.86; US: 56.68) 2005-2010: +11.61% (EU: +3.09%;US: +0.53)
Innovation and Structural change	*Index of economic impact of innovation* 2010-2011: 0.433 (EU: 0.612)	*Knowledge-intensity of the economy* 2010: 39.99 (EU:48.75; US: 56.25) 2000-2010: +2.22% (EU: +0.93%; US: +0.5%)
Competitiveness	*Hot-spots in key technologies* Energy, Environment, Food, agriculture and fisheries, Other transport technology	*HT + MT contribution to the trade balance* 2011: -17.38% (EU**: 4.2%; US: 1.93%) 2000-2011***: n.a. (EU**: +4.99%; US:-10.75%)

**The growth rate for Norway refers to the period 2001-2011.*
***The EU value is the weighted average of the trade balance of the Member States.*
****For the period 2000-2011 there are no data available to provide the annual growth rate. The negative values for this period indicates a structural deficit for the industry for the country.*

Norway has the second highest GDP per inhabitant in Europe, with the high GDP partly explaining the low R&D intensity level. The Norwegian economy is mainly based on traditional industrial activities related to the extraction of raw materials and natural resources (petroleum and natural gas, fish) and to their industrial processing into bulk products and semi-finished goods. These industries are less R&D intensive than industries such as pharmaceuticals and ICT, which partly explains why Norway's R&D intensity level was only 1.70% (in 2011), a lower value than the EU average of 2.03% and also lower than the R&D intensity of the United States (2.75% in 2011). Norway's R&D intensity has fluctuated over the period 2001-2011 reaching a high of 1.78% in 2009 and a low of 1.48% in 2006 and with an average annual growth rate of 0.7% (a little lower then EU growth rate). Norway has a higher level of S&T excellence and a higher growth rate for S&T excellence than the EU average.

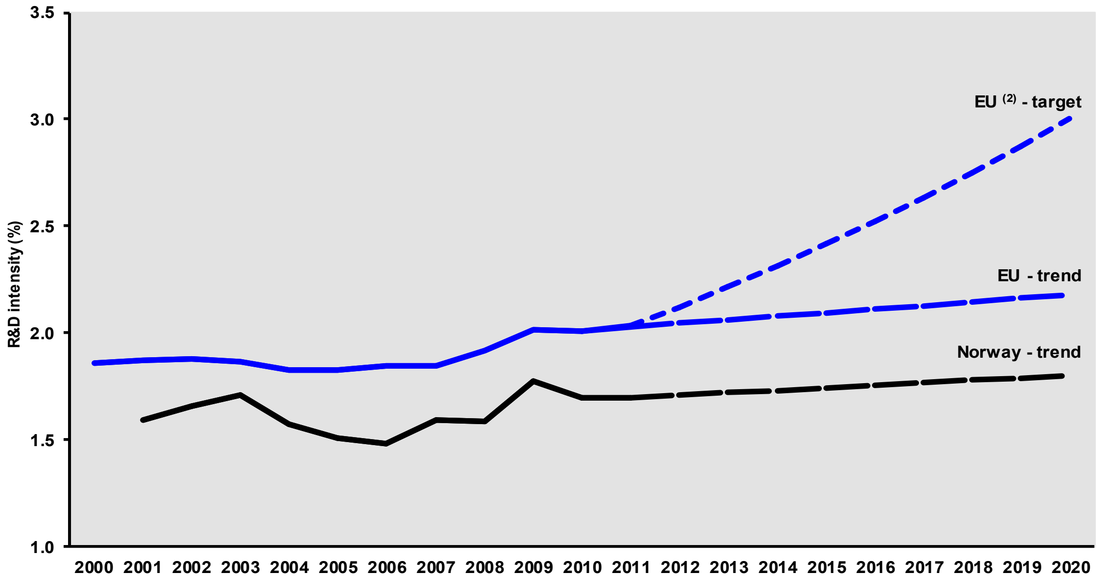
Norway is below the EU average in terms of the knowledge-intensity of its economy. Norway performs moderately on all indicators related to structural change (not visible in the table above). As part of the structural change, internationalization has become an overall priority of the government's R&I policy in the last years and the new internationalization strategy states that all activities of the RCN[4] must include clearly defined objectives and plans for international co-operation. Moreover, in terms of funding, there is a shift from instruments dedicated to internationalization towards including the internationalization dimension in all activities.

The low-tech nature of the Norway's economy is reflected also in the negative contribution to the trade balance of high-tech (HT) and medium-tech (MT) products, with imports much higher than exports for the last 11 years. There are no signs that this characteristic of the Norwegian economy will change in the coming years.

[4] Research Council of Norway

Investing in knowledge

Norway - R&D intensity projections, 2000-2020 (1)



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat
Notes: (1) The R&D intensity projections based on trends are derived from the average annual growth in R&D intensity for 2000-2011.in the the case of the EU and for 2001-2011 in the case of Norway.
(2) EU: This projection is based on the R&D intensity target of 3.0% for 2020.
(3) NO: An R&D intensity target for 2020 is not available.

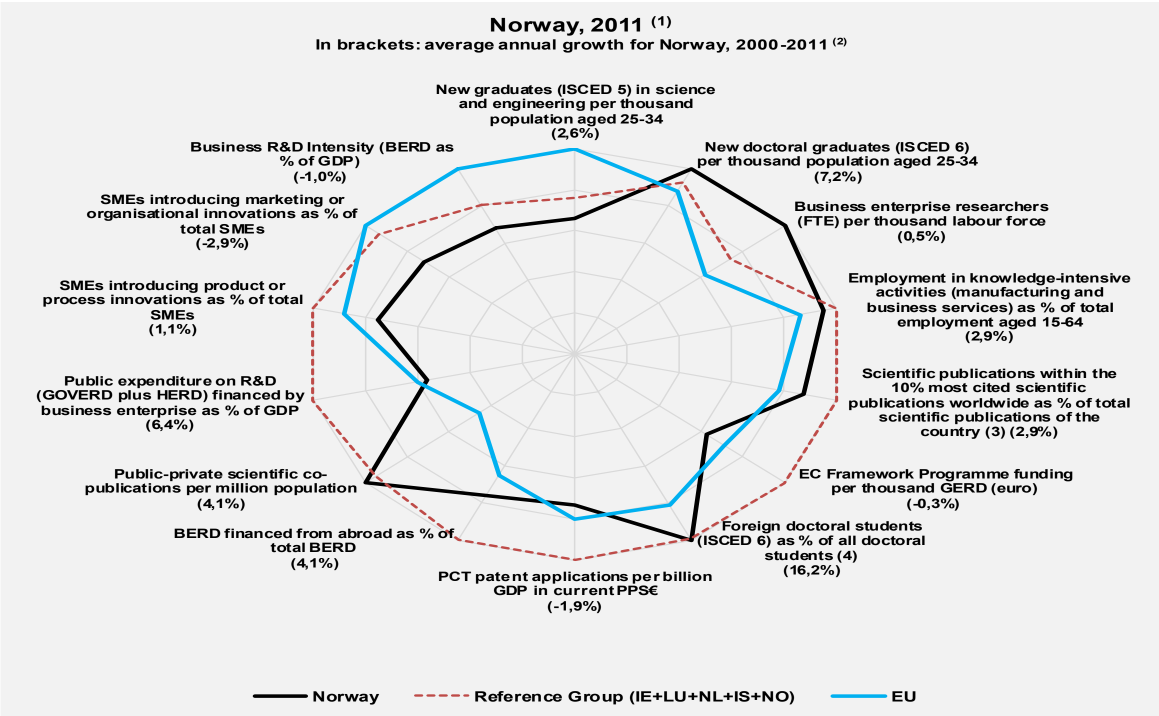
Norway's R&D intensity of 1.70% in 2011 is below the EU average. This is due to the particular nature of Norway's economy which is characterised by traditional industrial activities related to the extraction and processing of natural resources. In recent years, Norwegian policy makers have increasingly recognized that the low level of industrial R&D should be seen against the backdrop of the country's industrial structure. Although Norway's R&D intensity has fluctuated over the last decade, the average annual growth rate of its R&D intensity is close to that of the EU as a whole. If Norway's R&D intensity continues to grow at the same average annual growth rate, the R&D intensity value attained by Norway in 2020 will still be below the EU value and, in fact will be lower than 2%.

Over the last decade, total expenditure on R&D (GERD) in Norway has increased in real terms at an average annual growth rate of 2.1% while the corresponding growth rate for business expenditure on R&D (BERD) was 0.4%. The business enterprise sector accounts for 51% of Norwegian R&D and a large share of it is performed by SMEs. Norway's business R&D intensity of 0.86% in 2011 is much lower than the EU value of 1.26% and is far below the level of the other Nordic countries all of which have values higher than 2%. It is important to mention that the value excludes indirect support for R&D such as R&D tax credits which is the largest R&D support scheme for business in Norway. The country is therefore an outlier with regard to innovation, with a low-tech but very knowledge-intensive industry sector based on raw materials. This is reflected in the increasing share of SMEs introducing product or process innovations (1.1% growth over the period 2004-2010). On the other hand, the share of knowledge-intensive services exports in total service exports has grown at an average annual rate of 1.6% over the period 2004-2009.

The EU Framework Programmes are the most important international research programmes in which Norway participates. Norwegian researchers have participated in EU FPs since 1987. In FP7, Norway's participant success rate was 24.64%. The successful participants received a total EC financial contribution of € 563 million.

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

The graph below illustrates the strengths and weaknesses of the Norwegian innovation system. Reading clockwise, it provides information on human resources, scientific production, technology valorisation and innovation. Average annual growth rates from 2000 to the latest available year are given in brackets.



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat, OECD, Science Metrix / Scopus (Elsevier), Innovation Union Scoreboard
Notes: (1) The values refer to 2011 or to the latest available year.
(2) Growth rates which do not refer to 2000-2011 refer to growth between the earliest available year and the latest available year for which comparable data are available over the period 2000-2011.
(3) Fractional counting method.
(4) EU does not include DE, IE, EL, LU, NL.; Reference group does not include IE, LU, NL

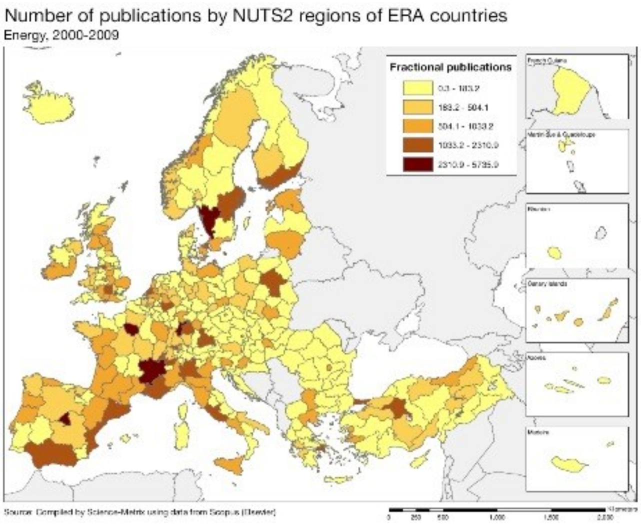
The excellent macroeconomic performance of the Norwegian economy does not yet translate into a high performance level for R&D and innovation. Overall, the Norwegian R&I system's relative strengths are in human resources, public-private cooperation, an attractive research system, financing and entrepreneurship (the latter two dimensions are not shown on the above graph). In the last decade, venture capital, an important financial tool for the business sector, has increased to 0.21% of GDP in 2011, with an average annual growth rate of 2.4%. In particular, the business sector is supported through a number of specific programs for seed venture capital whereby state venture capital is provided as a loan with a risk relief element. Areas of relative weakness are private sector investment, patenting levels and business innovations. The main structural challenges faced by the Norwegian innovation system are a relatively low level of science and engineering graduates, the need to increase industrial R&D and the need to increase innovation in firms. The main program for R&D grants to business is an open research arena for quality projects without thematic restrictions. There has been a shift from indirect to direct support for business R&D and innovation.

The Norwegian innovation system is adapted to knowledge-intensive industry supplemented by a strong service sector. Norway's innovation system is dominated by knowledge-intensive enterprises that rely on collaborative learning. Two other types of enterprise complete the system: enterprises operating with little knowledge accumulation, and small R&D-intensive enterprises that rely on collaborative learning and operate within global innovative networks. Norway's share of employment in knowledge-intensive activities is higher than the EU average but lower than its reference group of countries as shown on the above graph.

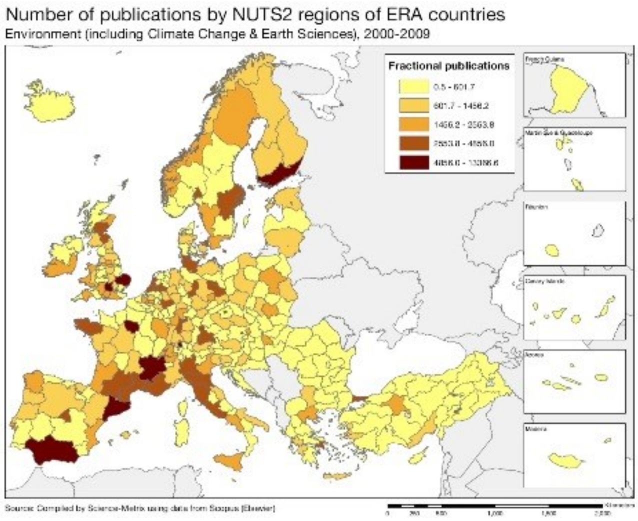
Norway's scientific strengths

The maps below illustrate four key science areas where Norway has real strengths in a European context. The maps are based on the number of scientific publications produced by authors and inventors based in the regions.

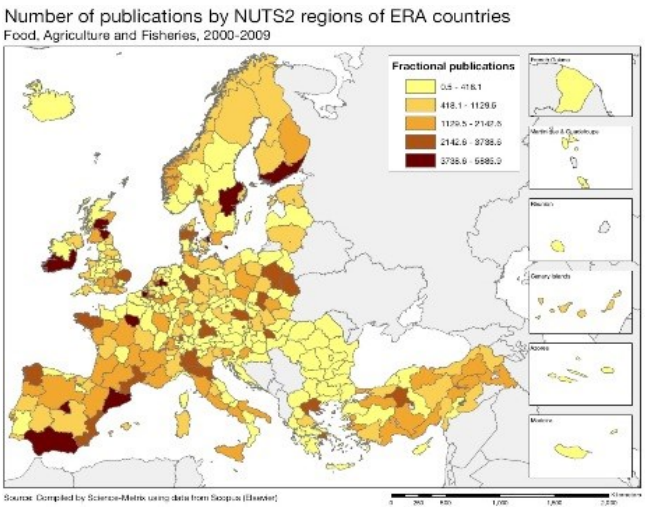
Energy (Scientific production)



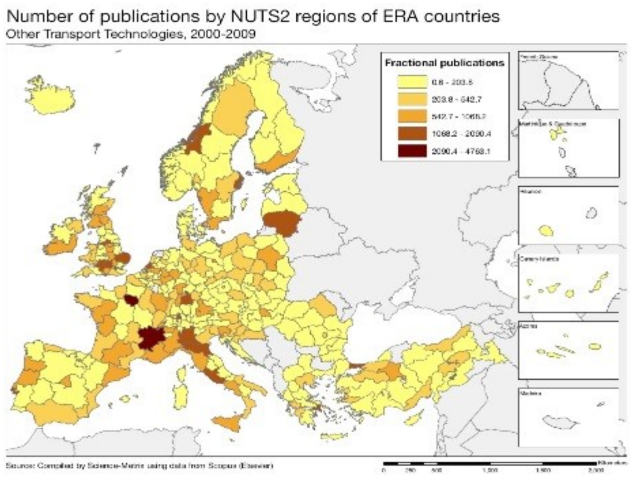
Environment (Scientific production)



Food, Agriculture and Fisheries (Scientific production)



Other Transport Technologies (Scientific production)

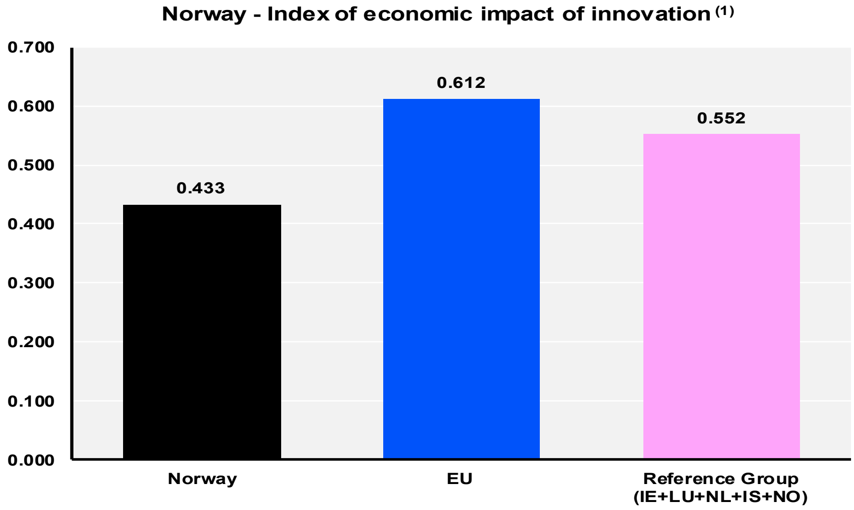


Norway's scientific production shows good results in the fields of energy, environment, food, agriculture and fisheries, and other transport technology[5]. Scientific activity is closely related to Norway's R&D strategies and takes into account the need to meet global challenges. It focuses particularly on environment, climate change, oceans, food safety and energy research.

[5] Railway vehicles (including hover trains) and associated equipment; aircraft and associated equipment; spacecraft (including satellites) and spacecraft launch vehicles; parts thereof; ships, boats (including hovercraft) and floating structures (SITC Rev.4).

Economic impact of innovation

The index below is a summary index of the economic impact of innovation composed of five of the Innovation Union Scoreboard's indicators[6].



Source: DG Research and Innovation - Economic Analysis Unit (2013)
Data: Innovation Union Scoreboard 2013, Eurostat
Note: (1) Based on underlying data for 2009, 2010 and 2011.

The situation of Norway's on this index as well as its score on each of its components reflects the specificities of its economic and trade structure. Despites scores higher than EU average on the employment in knowledge-intensive sectors and in the share of knowledge-intensive services export in total services export, the overall result is strongly influenced by the negative contribution of high-tech and medium-tech exports to the trade balance.

Although innovation performance refers to more than technology-driven innovation, it is to be noted that Norway has a number of policy measures the objective of which is to support R&D in companies. Overall public support for industrial R&D is relatively high in Norway, and the mix of instruments has remained largely stable for at least a decade.

The most significant innovation policy developments in Norway since mid- 2009 concern the follow up and implementation of the priorities outlined in the innovation White Paper. The objectives of innovation policy were to foster sustainable value creation, secure future job opportunities and protect welfare in order to respond to increasingly globalised challenges. The competitiveness of trade and industry is dependent on increased research activity in selected service, technology and industrial areas - industrial sectors that could replace the loss in value-creation that will occur when oil and gas production declines. Human resources are an important asset for innovation, value creation and growth and are essential for future growth in new knowledge-intensive sectors.

In order to further improve the quality and capacity of Norway's R&I system, research activity must promote the development of a more knowledge-intensive trade and industrial sector that invests in its own research and development, boosts expertise within the companies and enhances the ability of companies to make use of research conducted by others.

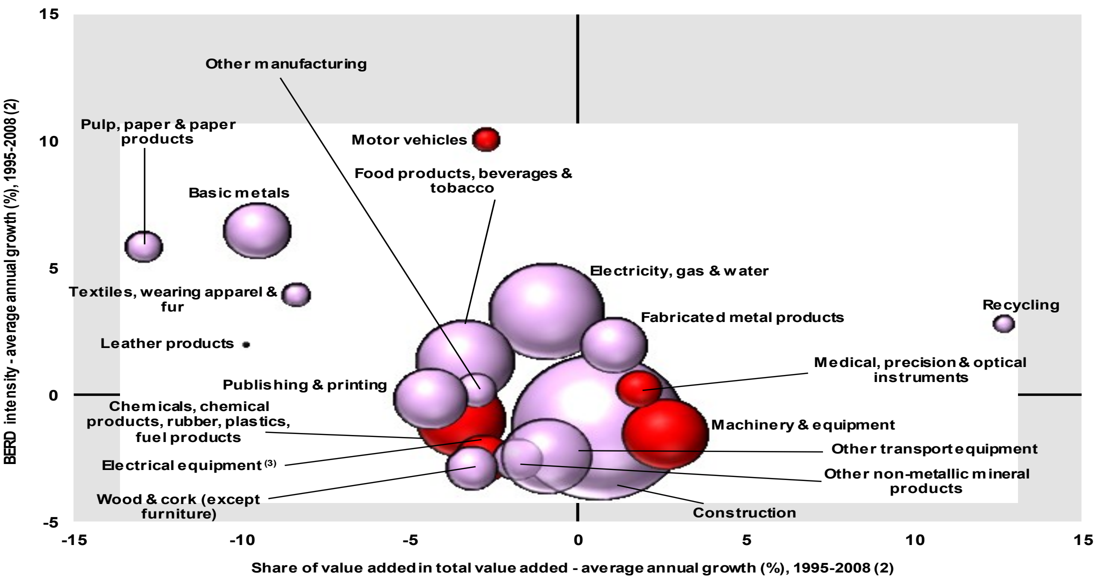
Environmental technologies or eco-innovations are an emerging and important field in Norwegian innovation policy. In June 2011, the government published a strategy for environmental technologies that describes the measures that the government intends to implement in order to create favourable conditions for the development of internationally competitive industries and markets for environmental technologies.

[6] See Methodological note for the composition of this index.

Upgrading the manufacturing sector through research and technologies

The graph below illustrates the upgrading of knowledge in different manufacturing industries. The position on the horizontal axis illustrates the changing weight of each industry sector in value added over the period. The general trend to the left-hand side reflects the decrease of manufacturing in the overall economy. The sectors above the x-axis are sectors whose research intensity has increased over time. The size of the bubble represents the share of the sector (in value added) in manufacturing (for all sectors presented on the graph). The red-coloured sectors are high-tech or medium-high-tech sectors.

Norway - Share of value added versus BERD intensity - average annual growth, 1995-2008



Source: DG Research and Innovation - Economic Analysis unit
Data: OECD
Notes: (1) High-Tech and Medium-High-Tech sectors are shown in red. 'Chemicals, chemical products, rubber, plastics, fuel products' and 'Other transport equipment' include High-Tech, Medium-High-Tech and Medium-Low-Tech,
(2) 'Electrical equipment', 'Motor vehicles", 'Other manufacturing', 'Other transport equipment': 1995-2007; 'Recycling': 1996-2007.
(3) 'Electrical equipment' includes: 'Office, accounting and computing machinery', 'Electrical machinery and apparatus', and 'Radio, TV and communication equipment'.

Norway has a particular industrial structure and as can be seen on the above graph there has been no significant change in R&D investments in the manufacturing sector over the period 1995-2008. Very few sectors have increased their R&D intensities and manufacturing in general has less weight in the overall economy. Most of the sectors are grouped near the axes intersection point, meaning that small variations in levels of R&D intensity are usually accompanied by small or no variations in shares of value added. There are some exceptions. In sectors such as basic metals, motor vehicles and pulp, paper and paper products, business R&D intensity has increased significantly although the share of value added is decreasing. Recycling is the only sector where a small increase in R&D intensity has been accompanied a significant increase in its share of value added, however, this sector is one of the smallest in the economy.

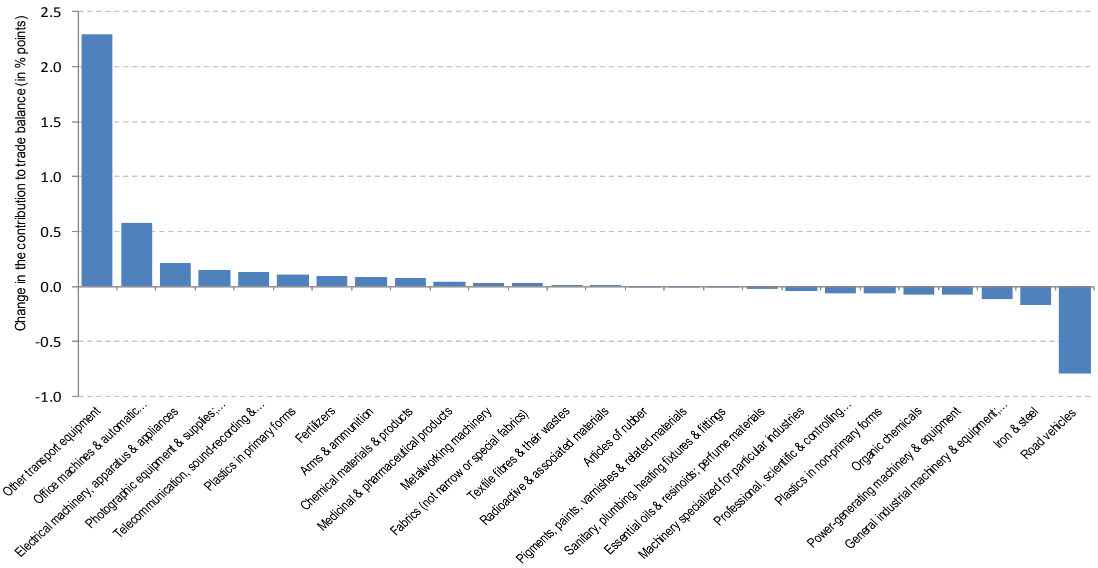
Over recent years, R&D policies and innovation strategies have been developed to focus on specific and representative areas of Norway's economy. These include the strategies for oil and gas, energy, climate, green growth, biotechnologies, nano-technologies and the maritime sector. At national level, there has been a broad political consensus on the need to foster more R&D intensive, knowledge-intensive manufacturing industries and services, exploiting both renewable and non-renewable energy technologies[7]. Therefore, green growth and environmental issues continue to develop as key areas for Science, Technology and Industry (STI), alongside prioritised technology fields such as bio- and nano-technology and ICT.

[7] Report on Science & Technology Indicators for Norway by the Research Council of Norway 2011

Competitiveness in global demand and markets

Investment in knowledge, technology-intensive clusters, innovation and the upgrading of the manufacturing sector are determinants of a country's competitiveness in global export markets. A positive contribution of high-tech and medium-tech products to the trade balance is an indication of specialisation and competitiveness in these products.

Evolution of the contribution of high-tech and medium-tech products to the trade balance for Norway between 2000 and 2011



Source: DG Research and Innovation - Economic Analysis unit
Data: COMTRADE
Notes: "Textile fibres & their wastes" refers only to the following 3-digits sub-divisions: 266 and 267.
"Organic chemicals" refers only to the following 3-digits sub-divisions: 512 and 513.
"Essential oils & resinoids; perfume materials" refers only to the following 3-digits sub-divisions: 553 and 554. "Chemical materials & products" refers only to the following 3-digits sub-divisions: 591, 593, 597 and 598. "Iron & steel" refers only to the following 3-digits sub-divisions: 671, 672 and 679.
"Metalworking machinery" refers only to the following 3-digits sub-divisions: 731, 733 and 737.

Over the period 2000-2011, Norway's trade balance had an upward trend, with an average annual growth of around 10.4%. For each year over the same period imports of high-tech (HT) and medium-tech (MT) products exceeded exports. The share of HT and MT imports in total HT and MT trade was lower in 2011 (70%) than in 2000 (72%). Over the period 2000-2011 some HT and MT products have increased their contributions to the trade balance (left side of the graph). The most significant increases were in other transport equipment[8] and office machines. The product with the biggest decrease in its contribution to the trade balance over 2000-2011 is road vehicles.

Norway's total factor productivity grew between 2000 and 2005 but then declined to reach a level in 2012 that is lower than the level in 2000. This type of evolution is not unusual due to the fact that the petroleum sector, a large part of Norway's economy, depends on physical oil production which is directly related to the characteristics of the actual reservoirs. As a result, production at a new well will rise for several years and then fall for even longer periods affecting the total factor productivity of the country. Norway's employment rate decreased slightly from 80.3% in 2000 to 79.6% in 2011 but remains much higher than the EU average of 68.6%. The share of population at risk of poverty or social exclusion has decreased by 1.1 percentage points between 2004 and 2011 to reach 14.6%.

Norway is the European country with the highest share of renewable energy in gross final energy consumption. Its share of 61.1% in 2010 is five times higher than the EU average. Greenhouse gas emissions in Norway have decreased over the last decade but are still significantly higher than the EU average. It is also noteworthy that in 2008 patents in environment-related technologies were at a considerably lower level than the EU average with only a slight increase since 2000. The level of patent applications in health-related technologies has decreased significantly between 2000 and 2008.

[8] idem 3

Key indicators for Norway

NORWAY	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average annual growth [1] (%)	EU average [2]
ENABLERS															
Investment in knowledge															
New doctoral graduates (ISCED 6) per thousand population aged 25-34	0.96	1.13	1.11	1.09	1.17	1.33	1.41	1.59	1.99	1.74	1.92	:	:	7.2	*1.69*
Business enterprise expenditure on R&D (BERD) as % of GDP	:	0.95	0.95	0.98	0.86	0.81	0.79	0.84	0.84	0.92	0.87	*0.86*	:	*-1.0*	*1.26*
Public expenditure on R&D (GOVERD + HERD) as % of GDP	:	0.64	0.71	0.73	0.71	0.70	0.69	0,76 [3]	0.74	0.86	0.83	*0,84* [4]	:	*3.0*	*0.74*
Venture Capital [5] as % of GDP	0.16	0.14	0.09	0.12	0.10	0.13	0.09	0.26	0.24	0.23	0.31	0.21	:	2.4	0,35 [6]
S&T excellence and cooperation															
Composite indicator of research excellence	:	:	:	:	:	29.9	:	:	:	:	51.8	:	:	11.6	47.9
Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country	9.7	9.8	10.1	10.5	10.7	11.0	11.4	11.1	12.2	:	:	:	:	2.9	10.9
International scientific co-publications per million population	464	450	462	691	813	916	1039	1139	1213	1335	1416	1483	:	11.1	300
Public-private scientific co-publications per million population	:	:	:	:	:	:	:	98	102	114	119	116	:	4.1	53
FIRM ACTIVITIES AND IMPACT															
Innovation contributing to international competitiveness															
PCT patent applications per billion GDP in current PPS€	4.3	3.9	4.0	3.4	3.6	3.5	3.2	3.1	2.9	3.6	:	:	:	-1.9	3.9
License and patent revenues from abroad as % of GDP	:	:	:	:	0.09	0.17	0.20	0.18	0.15	0.17	:	:	:	12.5	0.58
Sales of new to market and new to firm innovations as % of turnover	:	:	:	:	7.2	:	4.8	:	3.3	:	6.1	:	:	-2.7	14.4
Knowledge-intensive services exports as % total service exports	:	:	:	:	45.0	47.7	50.1	46.9	48.9	49.4	:	:	:	1.6	45.1
Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products	-19.77	-17.84	-17.42	-16.68	-18.05	-18.39	-18.26	-17.52	-17.73	-16.74	-16.46	-17.38	:	-	4,20 [7]
Growth of total factor productivity (total economy) - 2000 = 100	100	101	102	103	106	106	105	104	101	98	98	97	98	-2 [8]	103
Factors for structural change and addressing societal challenges															
Composite indicator of structural change	32.1	:	:	:	:	33.9	:	:	:	:	40.0	:	:	2.2	48.7
Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64	:	:	:	:	:	:	:	:	13.8	14.9	14.2	15.1	:	2.9	13.6
SMEs introducing product or process innovations as % of SMEs	:	:	:	:	30.8	:	29.8	:	28.9	:	32.8	:	:	1.1	38.4
Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€	0.22	0.14	0.18	0.20	0.22	0.24	0.21	0.30	0.24	:	:	:	:	1.0	0.39
Health-related technologies - patent applications to the EPO per billion GDP in current PPS€	0.55	0.33	0.45	0.31	0.37	0.29	0.32	0.29	0.23	:	:	:	:	-10.2	0.52
EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES															
Employment rate of the population aged 20-64 (%)	80.3	80.1	79.6	78.4	78.2	78.2	79.5	80.9	81.8	80.6	79.6	79.6	:	-0.1	68.6
R&D Intensity (GERD as % of GDP)	:	1.59	1.66	1.71	1.57	1.51	1.48	1.59	1.58	1.78	1.69	*1.70*	:	*0.7*	*2.03*
Greenhouse gas emissions - 1990 = 100	107	110	107	109	110	108	108	111	108	103	108	:	:	1 [9]	85
Share of renewable energy in gross final energy consumption (%)	:	:	:	:	58.4	60.1	60.6	60.5	62.0	65.1	61.1	:	:	0.8	12.5
Share of population aged 30-34 who have successfully completed tertiary education (%)	37.3	42.2	43.4	40.7	39.5	39.4	41,9 [10]	43.7	46.2	47.0	47.3	48.8	:	3.1	34.6
Share of population at risk of poverty or social exclusion (%)	:	:	:	:	15.8	16.2	16.9	16.5	15.0	15.2	14.9	14.6	:	-1.1	*24.2*

Source: DG Research and Innovation - Economic Analysis Unit

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 2000-2012.

(2) EU average for the latest available year.

(3) Break in series between 2007 and the previous years.

(4) Break in series between 2011 and the previous years. Average annual growth refers to 2007-2010.

(5) Venture Capital includes early-stage, expansion and replacement for the period 2000-2006 and includes seed, start-up, later-stage, growth, replacement, rescue/turnaround and buyout for the period 2007-2011.

(6) Venture Capital: EU does not include EE, CY, LV, LT, MT, SI, SK.

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

(8) The value is the difference between 2012 and 2000.

(9) The value is the difference between 2010 and 2000. A negative value means lower emissions.

(10) Break in series between 2006 and the previous years. Average annual growth refers to 2006-2011.

(11) Values in italics are estimated or provisional.

Switzerland

The challenge of structural change maintaining a leading competitive economy

Summary: Performance in research, innovation and competitiveness

The indicators in the table below present a synthesis of research, innovation and competitiveness in Switzerland. They relate knowledge investment and input to performance or 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 table includes a new index on excellence in science and technology which takes into consideration the quality of scientific production as well as technological development. The indicator on knowledge-intensity of the economy is an index on structural change that focuses on the sectoral composition and specialisation of the economy and shows the evolution of the weight of knowledge-intensive sectors and products and services.

	Investment and Input	Performance/economic output
Research	*R&D intensity* 2008: 2.87% (EU: 2.03%; US: 2.75%) 2000-2011[1]: +1.9% (EU: +0.8%; US: +0.2%)	*Excellence in S&T* 2010: 97.59 (EU:47.86; US: 56.68) 2005-2010: +3.42% (EU: +3.09%;US: +0.53)
Innovation and Structural change	*Index of economic impact of innovation* 2010-2011: 0.837 (EU: 0.612)	*Knowledge-intensity of the economy* 2010: 70.05 (EU:48.75; US: 56.25) 2000-2010: +2.11% (EU: +0.93%; US: +0.5%)
Competitiveness	*Hot-spots in key technologies* Energy, Environment, ICT, Nanosciences and Nanotechnologies	*HT + MT contribution to the trade balance* 2011: 8.44% (EU[2]: 4.2%; US: 1.93%) 2000-2011: +2.69% (EU[2]: +4.99%; US:-10.75%)

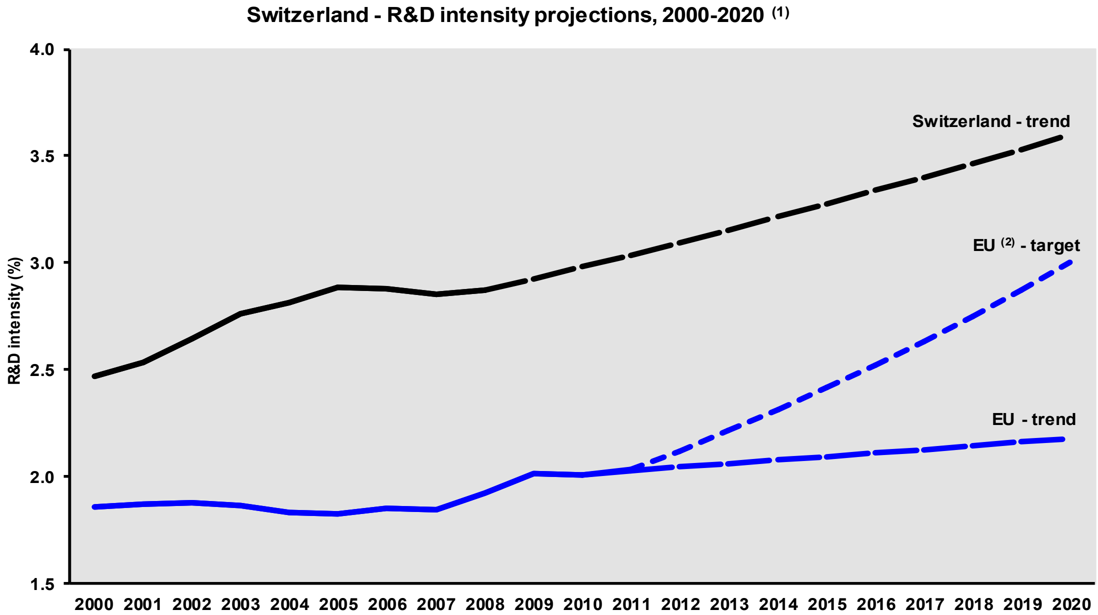
[1] *For Switzerland the growth rate is calculated for the period 2000-2008.*
[2] *The EU value is the weighted average of the trade balance of the Member States.*

Switzerland has a level of economic development that is amongst the highest in Europe. Swiss research policy is characterised by continuity and stability and Switzerland performs better in R&D than the EU (average) and the United States. Switzerland had an R&D intensity of 2.87% in 2008 (the latest available year) with an R&D intensity average annual growth rate of 1.9% over the period 2000-2008 both of which are higher than the corresponding values for EU (2.03% and 0.8%) and United States (2.75% and 0.2%).

The high level of R&D performance is accompanied by a high level of S&T excellence with Switzerland performing at a level that is almost double that of the EU. Switzerland is one of the most advanced countries in terms of the knowledge-intensity of its economy, and has made even further progress over the decade 2000-2010. The country performs well in all indicators that indicate the size of the knowledge economy. There is also a high performance on the cumulative inward and outward FDI stock as a share of GDP, the relative specialization in the exports of medium-high-tech and high-tech products (Revealed Competitive Advantage – RCA) and the share of value added in knowledge-intensive activities within the total value added of the country.

The contribution of high-tech (HT) and medium-tech (MT) products to the country's trade balance is much higher than the corresponding contributions in the EU as a whole and the United States, and is based on a very good performance of the knowledge-intensive sectors of the economy..

Investing in knowledge



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat
Notes: (1) The R&D Intensity projections based on trends are derived from the average annual growth in R&D intensity for 2000-2011 in the the case of the EU and for 2000-2008 in the case of Switzerland.
(2) EU: This projection is based on the R&D intensity target of 3.0% for 2020.
(3) CH: An R&D intensity target for 2020 is not available.
(4) CH: The values for 2001, 2002, 2003, 2005, 2006 and 2007 were interpolated by DG Research and Innovation.

The Swiss research system is of very good quality and is based on a clear-cut separation between the public sector, which is centred on very research-intensive universities, and the private sector, which is centred on the large research units of multinational companies. The main priority of Swiss national research and innovation (R&I) policies is to provide excellent framework conditions by fostering basic as well as applied research and technology transfer.

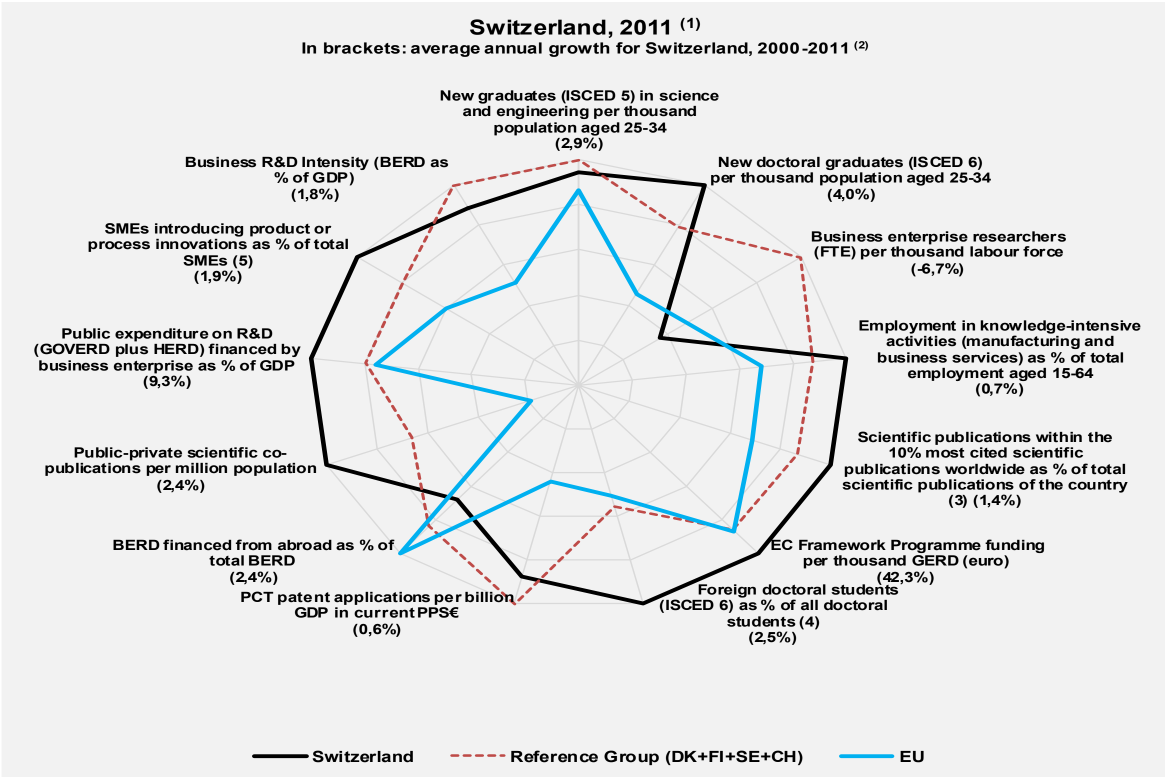
Switzerland has one of the highest R&D intensities both in Europe and in the world with a value of 2.87% in 2008. Over the last decade, R&D intensity grew at an average annual rate of 1.9%, well above the EU rate of 0.8% and if the same trend is continued, will reach 3.60% in 2020. Almost 74% of R&D is performed by the private sector. This is due to the specific structure of the Swiss economy which is dominated by large multinational companies with their own global strategies. Swiss research policy focuses mainly on the quality of the public research sector and on the training of skilled researchers. An important trend in public R&D expenditures is the increasing R&D expenditure for universities. As a result, over the period 2000-2010, total higher education expenditure on R&D increased in real terms at an average annual rate of 5%. In 2008, higher education expenditure on R&D as a percentage of total expenditure on R&D in Switzerland was approximately on the same level as the EU average (CH: 24.2%; EU: 23.0%).

The share of new doctoral graduates per thousand population aged 25-34 has increased from 2.7% in 2002 to 3.6% in 2009, a value which is more than double the EU average. Switzerland's competitive R&I system is maintained by intensive and successful scientific activity as shown by a high share of scientific publications within the 10% most cited scientific publication worldwide (15.8% in 2008), a high number of international scientific co-publications per million population (2505 in 2011), a high level of PCT patent applications per billion GDP (7.8 in 2009) and a high level of licensing and patent revenues from abroad as % of GDP (2.95% in 2011).

Switzerland has a good tradition of participating in international programs at European level. Switzerland's participant success rate in the EC Seventh Framework Programme was 25%. The successful participants received a total EC financial contribution of € 1.3 billion.

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

The graph below illustrates the strengths and weaknesses of Switzerland's R&I system. Reading clockwise, it provides information on human resources, scientific production, technology valorisation and innovation. Average annual growth rates from 2000 to the latest available year are given in brackets.



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat, OECD, Science Metrix / Scopus (Elsevier), Innovation Union Scoreboard
Notes: (1) The values refer to 2011 or to the latest available year.
(2) Growth rates which do not refer to 2000-2011 refer to growth between the earliest available year and the latest available year for which comparable data are available over the period 2000-2011.
(3) Fractional counting method.
(4) EU does not include DE, IE, EL, LU, NL.
(5) CH is not included in the reference group.

The Swiss research and innovation system is characterized by a very strong scientific and technological production that outperforms the EU on almost all the indicators analysed in the graph above, making Switzerland an innovation leader.

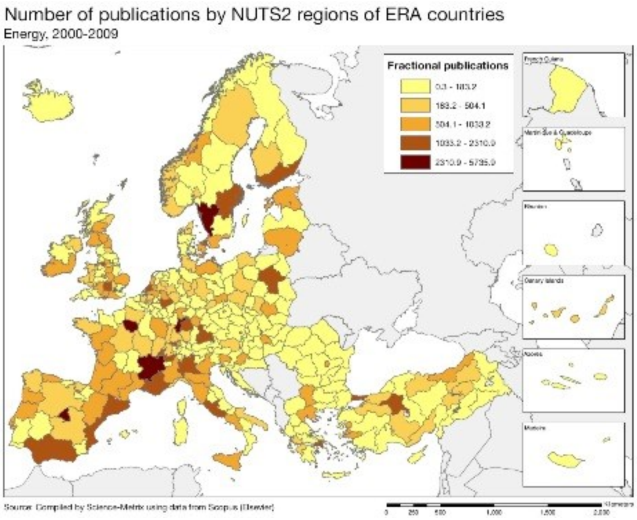
An important weakness in the Swiss R&I system is the relatively low level and the significant decrease in the number of researchers employed by business enterprises. A lack of researchers could become a problem in the future for Switzerland. Although the number of graduates in the fields of science and engineering per thousand population aged 25-34 has increased at an average annual growth rate of 2.9% over the period 2002-2010, there is still an insufficient supply of graduates in these fields. Another challenge facing the Swiss R&I system (not visible in the graph above) is the need to improve education and training curricula in relation to entrepreneurial education and the teaching of intercultural and communications skills.

Although business expenditure on R&D (BERD) as a percentage of total expenditure on R&D is very high in Switzerland (73.5%), the share of business expenditure financed from abroad is lower than both the EU average and Switzerland's reference group of countries. Switzerland outperforms both the EU and its reference group of countries in terms of production of scientific publications, public-private scientific co-publications, share of foreign doctoral students in all doctoral students and share of employment in knowledge-intensive activities in total employment aged 15-64.

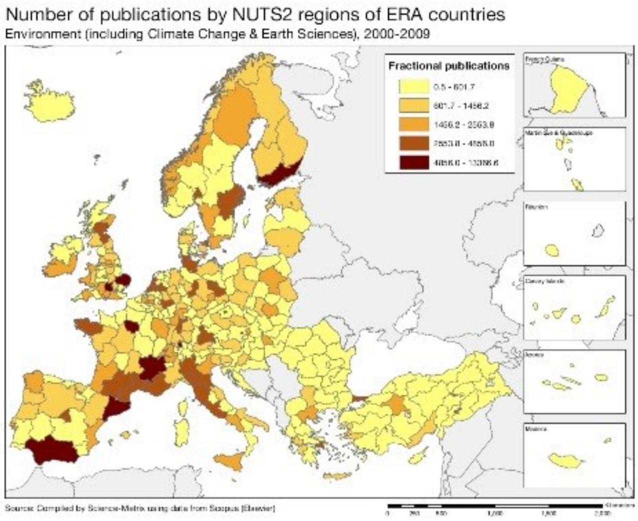
Switzerland's scientific strengths

The maps below illustrate four key science areas where Switzerland has real strengths in a European context. The maps are based on the number of scientific publications produced by authors and inventors based in the regions.

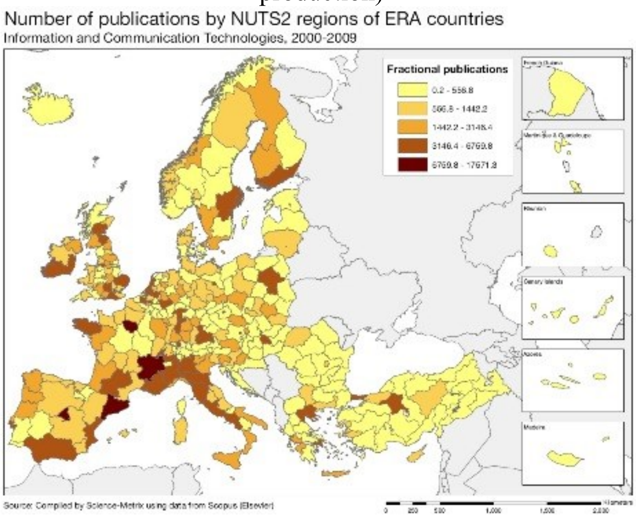
Energy (Scientific production)



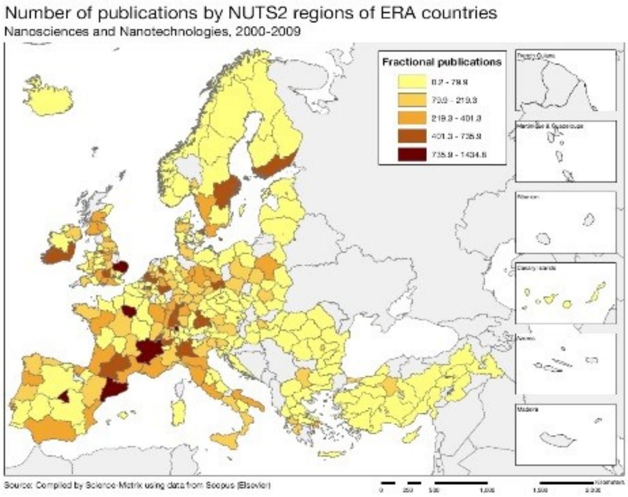
Environment (Scientific production)



Information and Communication Technologies (Scientific production)



Nanosciences and Nanotechnologies (Scientific production)

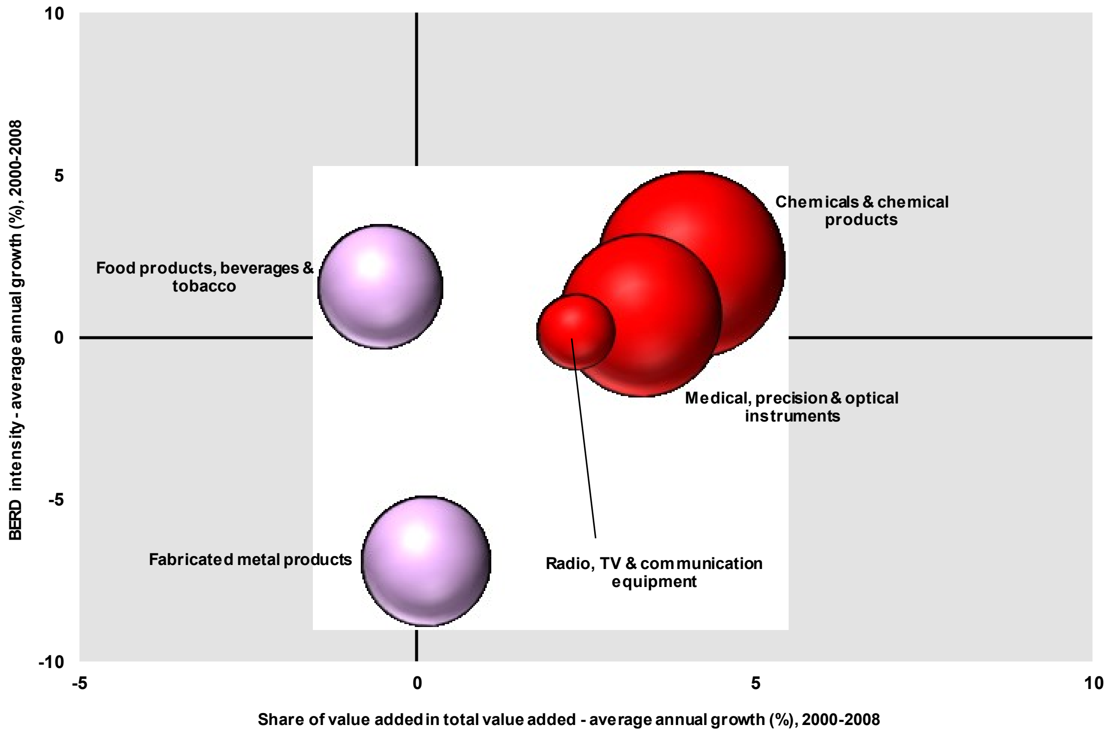


Switzerland's scientific production shows good results in the fields of energy, environment, information and communication technology (ICT), and nano-sciences and nanotechnologies. In Switzerland, almost all public sector research is carried out in higher education institutions and research policy is focused mainly on basic and applied research in universities. Switzerland has taken an important step to improve and strengthen its universities and to allow them to position themselves in the European and international context by adopting a new higher education act that will provide a common regulatory framework for the whole system.

Upgrading the manufacturing sector through research and technologies

The graph below illustrates the upgrading of knowledge in different manufacturing industries. The position on the horizontal axis illustrates the changing weight of each industry sector in value added over the period. The general trend to the left-hand side reflects the decrease of manufacturing in the overall economy. The sectors above the x-axis are sectors whose research intensity has increased over time. The size of the bubble represents the share of the sector (in value added) in manufacturing (for all sectors presented on the graph). The red-coloured sectors are high-tech or medium-high-tech sectors.

Switzerland - Share of value added versus BERD intensity - average annual growth, 2000-2008



Source: DG Research and Innovation - Economic Analysis unit
Data: OECD
Note: (1) High-Tech and Medium-High-Tech sectors are shown in red.

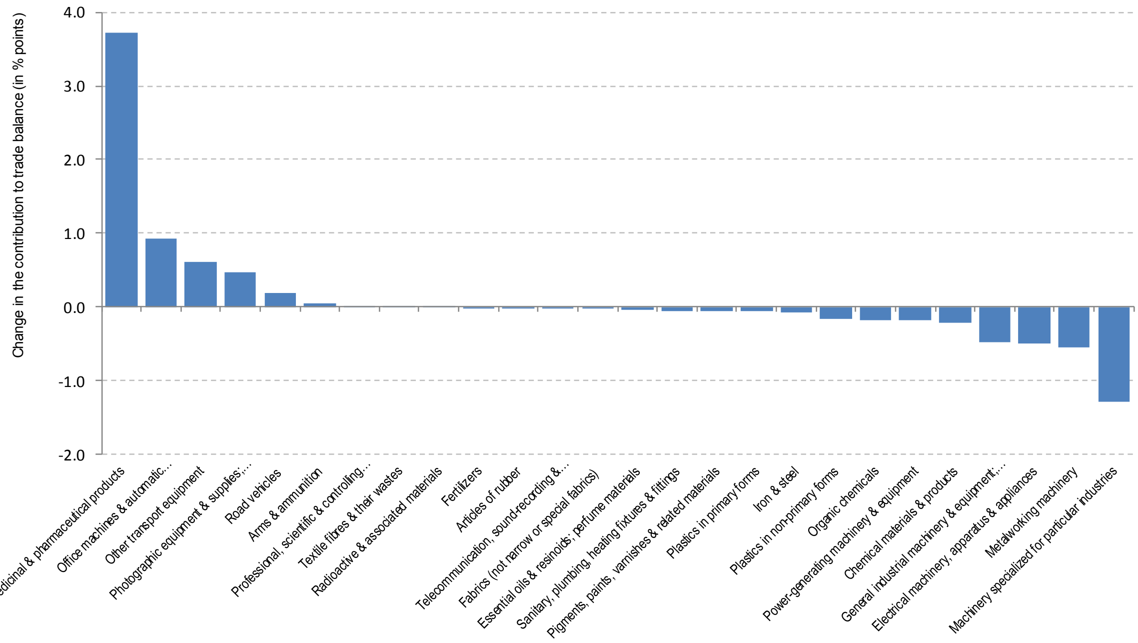
R&I excellence plays an important part in Swiss manufacturing. Switzerland displays a strong specialization in a number of technologically-intensive sectors, including the chemicals, pharmaceuticals, medical, precision and optical instruments industries. High-tech sectors make an important and increasing contribution to the Swiss economy in terms of value added.

Business R&D intensities and shares of value added show average annual increases over the period 2000-2008 for medical, precision and optical instruments, chemicals and chemical products, and Radio, TV and communication equipment. The challenge for Switzerland is to achieve the same competitive advantages in the new emerging sectors in which the country has scientific and technological strengths, in particular energy, environment and nanotechnologies. In this regard, partnerships between higher education institutes, research centres and business are actively promoted. Policies and instruments such as knowledge transfer platforms and voucher systems are in place to encourage cooperation and knowledge sharing and to create a more favourable business environment for SMEs.

Competitiveness in global demand and markets

Investment in knowledge, technology-intensive clusters, innovation and the upgrading of the manufacturing sector are determinants of a country's competitiveness in global export markets. A positive contribution of high-tech and medium-tech products to the trade balance is an indication of specialisation and competitiveness in these products.

Evolution of the contribution of high-tech and medium-tech products to the trade balance for Switzerland between 2000 and 2011



Source: DG Research and Innovation - Economic Analysis unit
Data: COMTRADE
Notes: "Textile fibres & their wastes" refers only to the following 3-digits sub-divisions: 266 and 267.
"Organic chemicals" refers only to the following 3-digits sub-divisions: 512 and 513.
"Essential oils & resinoids; perfume materials" refers only to the following 3-digits sub-divisions: 553 and 554. "Chemical materials & products" refers only to the following 3-digits sub-divisions: 591, 593, 597 and 598. "Iron & steel" refers only to the following 3-digits sub-divisions: 671, 672 and 679.
"Metalworking machinery" refers only to the following 3-digits sub-divisions: 731, 733 and 737.

Over the period 2000-2011 the characteristics of the Swiss trade balance have not changed significantly. The evolution of the shares of imports and exports of HT and MT products in total imports and exports shows little variation - the HT and MT share of total imports decreased by 2.28% while the HT and MT share of total exports increased by 2.06%. Overall the contribution of HT and MT goods to the trade balance has increased over the period 2000-2011. HT and MT goods represent 56% of total trade. In terms of contribution to the trade balance, the graph above shows that over the period 2000-2011, medical and pharmaceutical products had the highest increase whereas metalworking machinery, and machinery specialized for particular industries had the biggest decreases.

In Switzerland total factor productivity has increased by 7% between 2000 and 2012. Switzerland has one of the highest employment rates in the world at 81.8% in 2011, much higher than the EU average of 68.6%. The high rate of employment is associated with an increasing share of population aged 30-34 with tertiary education (44% in 2011) and a decreasing share of the population at risk of poverty or social exclusion (17.3% in 2011).

Switzerland has one of the highest business R&D intensities in Europe, 2.11% in 2008 (the latest available year). This value has been increasing at an average annual rate 1.8% over the period 2000-2008. However, the high level of private sector R&D and the relatively low level of public sector expenditure on R&D could be considered as a challenge for the Swiss R&I system. The bottom-up approach to knowledge demand is characterized by a strong and an extensive involvement of social and economic stakeholders in the design of research policy where decision on research direction is left to researchers and private companies.

Key indicators for Switzerland

SWITZERLAND	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average annual growth [1] (%)	EU average [2]
ENABLERS															
Investment in knowledge															
New doctoral graduates (ISCED 6) per thousand population aged 25-34	:	:	2.70	2.68	2.93	3.31	3.42	3.49	3.44	3.58	3.68	:	:	4.0	*1.69*
Business enterprise expenditure on R&D (BERD) as % of GDP	1.82	:	:	:	2.08	:	:	:	2.11	:	:	:	:	1.8	*1.26*
Public expenditure on R&D (GOVERD + HERD) as % of GDP	0.60	:	0.65	:	0.67	:	0.66	:	0.71	:	0.79	:	:	2.9	*0.74*
Venture Capital [3] as % of GDP	0.07	0.06	0.09	0.05	0.04	0.11	0.12	0.26	0.35	0.18	0.37	0.14	:	6.6	*0,35* [4]
S&T excellence and cooperation															
Composite indicator of research excellence	:	:	:	:	:	82.5	:	:	:	:	97.6	:	:	3.4	47.9
Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country	14.2	14.9	14.3	14.4	15.0	15.4	15.8	15.4	15.8	:	:	:	:	1.4	10.9
International scientific co-publications per million population	992	869	953	1392	1593	1724	1861	2056	2110	2222	2351	2505	:	8.8	300
Public-private scientific co-publications per million population	:	:	:	:	:	:	:	253	254	269	281	278	:	2.4	53
FIRM ACTIVITIES AND IMPACT															
Innovation contributing to international competitiveness															
PCT patent applications per billion GDP in current PPS€	7.4	8.1	7.8	8.1	8.8	9.0	8.6	9.0	7.8	7.8	:	:	:	0.6	3.9
License and patent revenues from abroad as % of GDP	:	:	:	:	1.74	2.24	1.97	2.07	2.17	2.93	3.00	2.95	:	7.8	0.58
Sales of new to market and new to firm innovations as % of turnover	:	:	:	:	10.7	:	:	:	24.9	:	:	:	:	23.5	14.4
Knowledge-intensive services exports as % total service exports	:	:	:	:	34.7	37.4	37.3	38.3	34.2	30.3	26.5	:	:	-4.4	45.1
Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products	6.30	7.56	6.11	6.10	6.32	6.98	7.56	7.58	8.28	8.17	8.02	8.44	:	-	4,20 [5]
Growth of total factor productivity (total economy) - 2000 = 100	100	100	99	99	101	103	105	107	107	105	107	107	107	7 [6]	103
Factors for structural change and addressing societal challenges															
Composite indicator of structural change	56.8	:	:	:	:	64.1	:	:	:	:	70.0	:	:	2.1	48.7
Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64	:	:	:	:	:	:	:	:	19.5	19.9	19,8 [7]	20.0	:	0.7	13.6
SMEs introducing product or process innovations as % of SMEs	:	:	:	:	52.9	:	:	:	57.0	:	:	:	:	1.9	38.4
Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€	0.42	0.47	0.47	0.42	0.47	0.53	0.49	0.67	0.55	:	:	:	:	3.4	0.39
Health-related technologies - patent applications to the EPO per billion GDP in current PPS€	2.28	2.30	2.22	2.56	2.50	2.78	2.62	2.46	2.18	:	:	:	:	-0.6	0.52
EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES															
Employment rate of the population aged 20-64 (%)	80.9	81.9	81.2	80.2	80.0	79.9	80.5	81.3	82.3	81.7	81,1 [8]	81.8	:	0.1	68.6
R&D Intensity (GERD as % of GDP)	2.47	:	:	:	2.82	:	:	:	2.87	:	:	:	:	1.9	*2.03*
Greenhouse gas emissions - 1990 = 100	98	100	98	100	101	103	102	98	101	99	102	:	:	4 [9]	85
Share of renewable energy in gross final energy consumption (%)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Share of population aged 30-34 who have successfully completed tertiary education (%)	27.3	27.3	30.0	32.4	32.8	33.4	35.0	36.5	41.3	43.4	44.2	44.0	:	4.4	34.6
Share of population at risk of poverty or social exclusion (%)	:	:	:	:	:	:	:	:	18.6	17.2	17.2	17.3	:	-2.4	*24.2*

Source: DG Research and Innovation - Economic Analysis Unit

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 2000-2012.

(2) EU average for the latest available year.

(3) Venture Capital includes early-stage, expansion and replacement for the period 2000-2006 and includes seed, start-up, later-stage, growth, replacement, rescue/turnaround and buyout for the period 2007-2011.

(4) Venture Capital: EU does not include EE, CY, LV, LT, MT, SI, SK.

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

(6) The value is the difference between 2012 and 2000.

(7) Break in series between 2010 and the previous years. Average annual growth refers to 2010-2011.

(8) Break in series between 2010 and the previous years. Average annual growth refers to 2000-2009.

(9) The value is the difference between 2010 and 2000. A negative value means lower emissions.

(10) Values in italics are estimated or provisional.

Turkey

The challenge of structural change for a more competitive economy

Summary: Performance in research, innovation and competitiveness

The indicators in the table below present a synthesis of research, innovation and competitiveness in Turkey. They relate knowledge investment and input to performance or 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 table includes a new index on excellence in science and technology which takes into consideration the quality of scientific production as well as technological development. The indicator on knowledge-intensity of the economy is an index on structural change that focuses on the sectoral composition and specialisation of the economy and shows the evolution of the weight of knowledge-intensive sectors and products and services.

	Investment and Input	Performance/economic output
Research	*R&D intensity* 2011: 0.84% (EU: 2.03%; US: 2.75%) 2000-2011: +5.82% (EU: +0.8%; US: +0.2%)	*Excellence in S&T* 2010:13.79 (EU:47.86; US: 56.68) 2005-2010: +2.52% (EU: +3.09%;US: +0.53)
Innovation and Structural change	*Index of economic impact of innovation* 2010-2011: 0.315 (EU: 0.612)	*Knowledge-intensity of the economy* 2010:18.6 (EU:48.75; US: 56.25) 2000-2010: +0.92% (EU: +0.93%; US: +0.5%)
Competitiveness	*Hot-spots in key technologies* Energy, Water, Food, Space	*HT + MT contribution to the trade balance* 2011: -2.22% (EU[1]: 4.2%; US: 1.93%) 2000-2011[2]: n.a. (EU[1]: +4.99%; US:-10.75%)

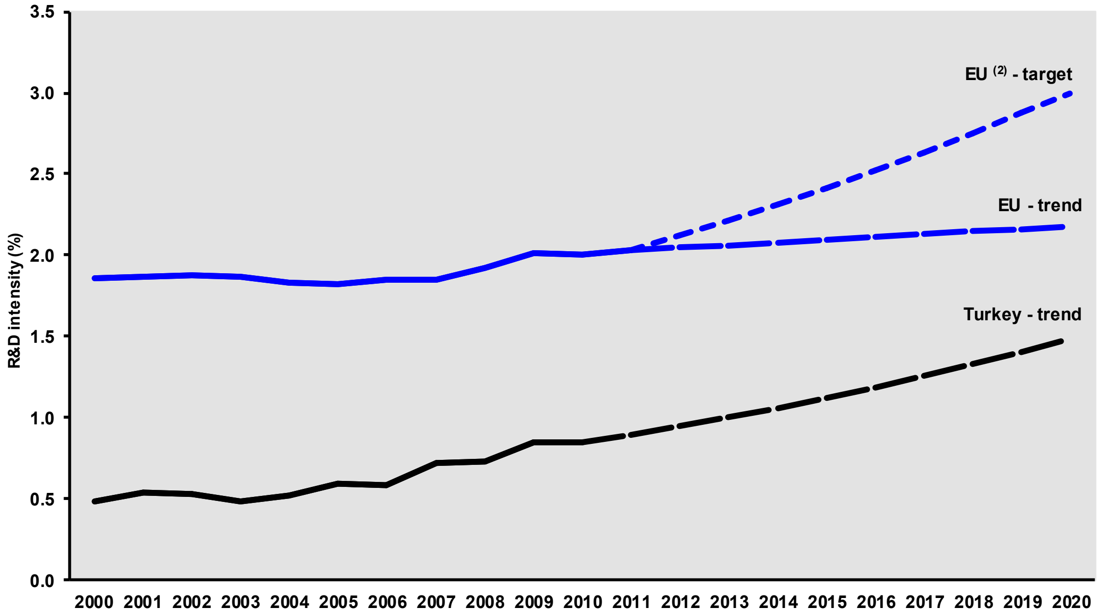
[1]*The EU value is the weighted average of the trade balance of the Member States.*
[2]*For the period 2000-2010 there are no data available to provide the annual growth rate. The negative values for this period indicates a structural deficit for the industry for the country.*

Since the early 2000s, Turkey has devoted increasing importance to investment in science, technology and innovation as shown by the continuous increase in Government funding for R&D and innovation activities. The growing political commitment to science, technology and innovation has also been reflected in the Ninth Development Plan (2007–2013), which was issued in 2006. The Plan identifies improving science and technology performance as one of the building blocks for greater competitiveness.

The new science, technology and innovation strategy document, National Science, Technology and Innovation Strategy, covering the period 2011-2016 was approved by the Supreme Council of Science and Technology (BTYK) in December 2010. It aims to create more output from existing research capacity and to enhance needs-oriented research capacity and defines strategic focus areas for increased science, technology and innovation performance. Target-oriented approaches are identified in the areas where Turkey has R&D and innovation capacities, demand-oriented approaches where further R&D and innovation efforts are needed and bottom-up approaches (including basic, applied and frontier research) are also an option.

Investing in knowledge

Turkey - R&D intensity projections, 2000-2020 (1)



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat
Notes: (1) The R&D intensity projections based on trends are derived from the average annual growth in R&D intensity for 2000-2011.
(2) EU: This projection is based on the R&D intensity target of 3.0% for 2020.
(3) TR: An R&D intensity target for 2020 is not available.

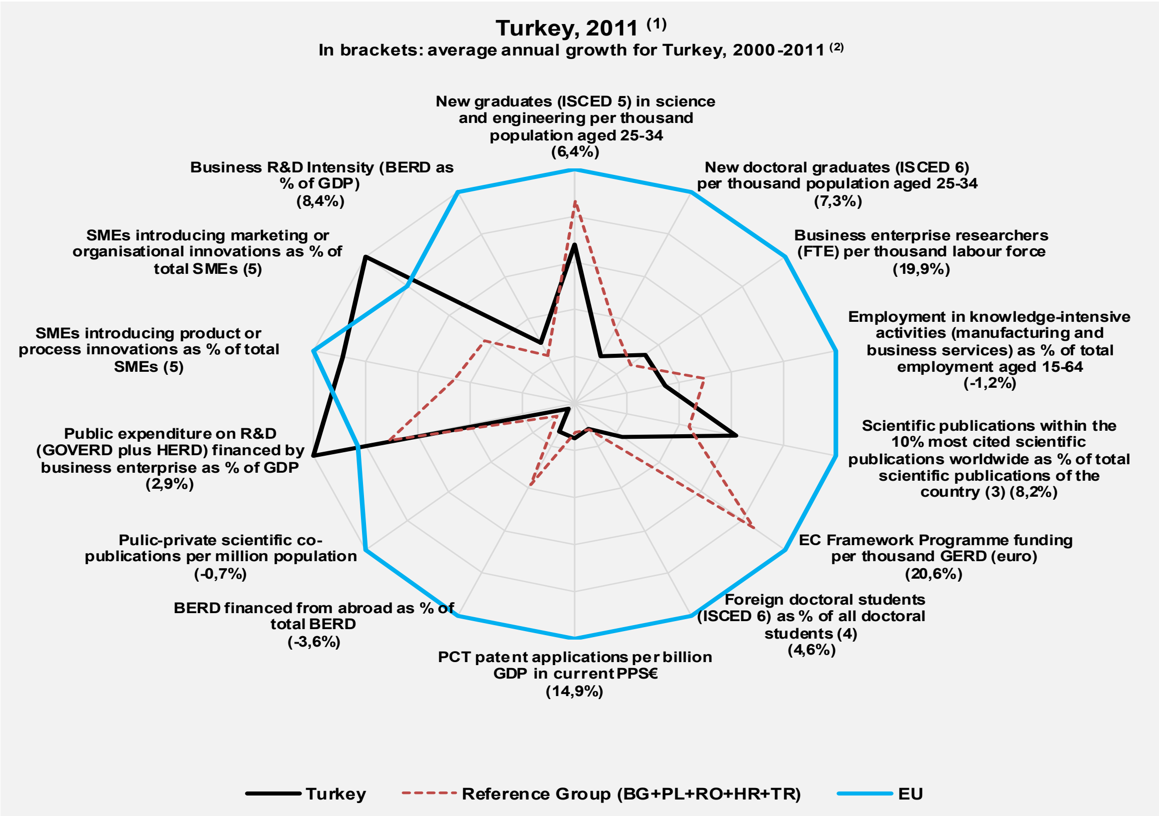
R&D intensity in Turkey has increased progressively from 0.48% in 2000 to 0.84% in 2010. Over this period R&D intensity has experienced an average annual growth rate of 5,8%. If this trend continues Turkey will have an R&D intensity of 1.48% in 2020, a very good achievement although still below the projected European Union average for 2020.

Turkey's R&D intensity decreased from 0.85% in 2009 to 0.84% in 2010 due to a corresponding decrease in public R&D intensity from 0.51% to 0.48%. Despite the decrease in Public R&D intensity and the economic crisis, R&D expenditure in all sectors has increased and business R&D intensity has grown from 0.34% in 2009 to 0.36% in 2010. Although Turkey's business R&D intensity is still well below the EU average of 1.26%, it is involved in a positive catching up process with an average annual growth rate of 8.4%.

Turkish research and innovation are also benefitting from support from the EU budget. The main instrument is the 7th Framework Program for Research and Development. The total number of participants in the 7th Framework Program in Turkey is 879 (out of 5982 applicants), receiving more than € 145,1 million. The success rate of participants of 14,7 % is below the EU average success rate of 21.95 %.

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

The graph below illustrates the strengths and weaknesses of Turkey's R&I system. Reading clockwise, it provides information on human resources, scientific production, technology valorisation and innovation. Average annual growth rates from 2000 to the latest available year are given in brackets.



Source: DG Research and Innovation - Economic Analysis Unit
Data: DG Research and Innovation, Eurostat, OECD, Science Metrix / Scopus (Elsevier), Innovation Union Scoreboard
Notes: (1) The values refer to 2011 or to the latest available year.
(2) Growth rates which do not refer to 2000-2011 refer to growth between the earliest available year and the latest available year for which comparable data are available over the period 2000-2011.
(3) Fractional counting method.
(4) EU does not include DE, IE, EL, LU, NL.
(5) TR is not included in the reference group.

The graph above shows that the Turkish research and innovation system is still weaker than the EU average in all areas except innovation in SMEs and public expenditure on R&D financed by business enterprise as a % of GDP. On the other hand, the average annual growth rates for most of the indicators indicate a progressive increase.

Most vulnerable areas include human resources, patents and public-private scientific co- publications. In particular Turkey is behind countries with similar knowledge capacity and economic structure in human resources with new graduates in science and engineering and new doctoral graduates showing especially low averages. Nevertheless, the research and innovation system in Turkey has relative strength in the quality of its scientific production, with an average annual growth of 8,2 % in the share of its scientific publications among the top 10 % most cited worldwide.

Policies and reforms for research and innovation

Eight sectors are identified as priority areas in UBTYS 2011-2016 in Turkey. These include automotive, machinery and manufacturing technologies, ICT, energy, water, food, space and defense. The sector-oriented standpoint adopted within UBTYS 2011-2016 has been promoted by two result driven and targeted call based funding programs which were recently set up by TUBITAK. Accordingly, temporary governance mechanisms have been established by TUBITAK in automotive, machinery and manufacturing technologies, and also in the ICT, energy, water and food areas which are designed to enable a bottom-up approach and an entrepreneurial discovery of the technology needs of each sector. These governance mechanisms are comprised of high level representatives from academia, the private sector, and the public sector. In the high level prioritization meetings of these actors, a consultative and a consensus building process takes place to designate R&D priorities in each sector. Calls through the aforementioned funding programs are opened in each sector in the technology needs/topics that have been previously identified and prioritized at the high-level prioritization meetings

The most recent STI priorities in Turkey include the decrees adopted in the 23rd and 24th meetings of BTYK which have set new targets for the national innovation and entrepreneurship system of Turkey. The main themes of these meetings were “Ecosystem of innovation and entrepreneurship in Turkey” and “Human resources for STI”. Regarding these themes, 17 new decrees were adopted which are being implemented in coordination with all relevant ministries and stakeholders.

The national innovation and entrepreneurship system targets have been renewed and targets have been set for the year 2023 with the objective of being one of the top 10 economies in the world by 2023. The 2023 targets for the National Innovation and Entrepreneurship System of Turkey are as follows:

- To increase R&D intensity to 3%
- To increase business R&D intensity to 2%
- To raise the number of full-time equivalent (FTE) researchers to 300,000
- To raise the number of FTE researchers in business to 180,000

The private sector is considered to be the driving force for many improvements and therefore supportive decrees were adopted both for increasing the private sector’s activities and fostering collaboration between the private sector and universities. For example, it has been decided to develop policies to provide R&D intensive start-ups with ready access to finance and complementary mentorship support at all stages of the life cycle of start-ups and to adoptembracing a tailor-made approach. It has also been decided to establish an adequate innovation and entrepreneurship ecosystem to increase the number of R&D intensive start-ups in Turkey. Furthermore, governmental organizations will be allowed to participate in venture capital funds in order to increase their effectiveness, especially in the seed funding and start-up capital phases. In this way it is hoped to reinvigorate venture capital funding in Turkey. These measures are expected to activate and enhance the commercialization process of research results.

Another example can be given by the decree aims at developing policy tools to trigger innovation and entrepreneurship in the universities by

- developing proper mechanisms to support technology transfer offices with an aim to trigger the commercialization of research conducted at universities
- developing proper mechanisms to support technology incubators with an aim to provide a gateway between universities and technoparks
- developing an index to measure the entrepreneurship and innovativeness performances of universities with an aim to increase the entrepreneurship and innovation oriented competition between universities
- redesigning academic promotion criteria to foster entrepreneurship and innovative activities by academicians

In line with this decree, in 2012, a university index has been developed to evaluate the entrepreneurship and innovativeness performance of universities based on such criteria as R&D projects, university-industry collaborations, international collaborations, articles, licences and spin-offs. The 50 most entrepreneurial universities in Turkey were listed for the first time, and this list will be renewed and published each year.

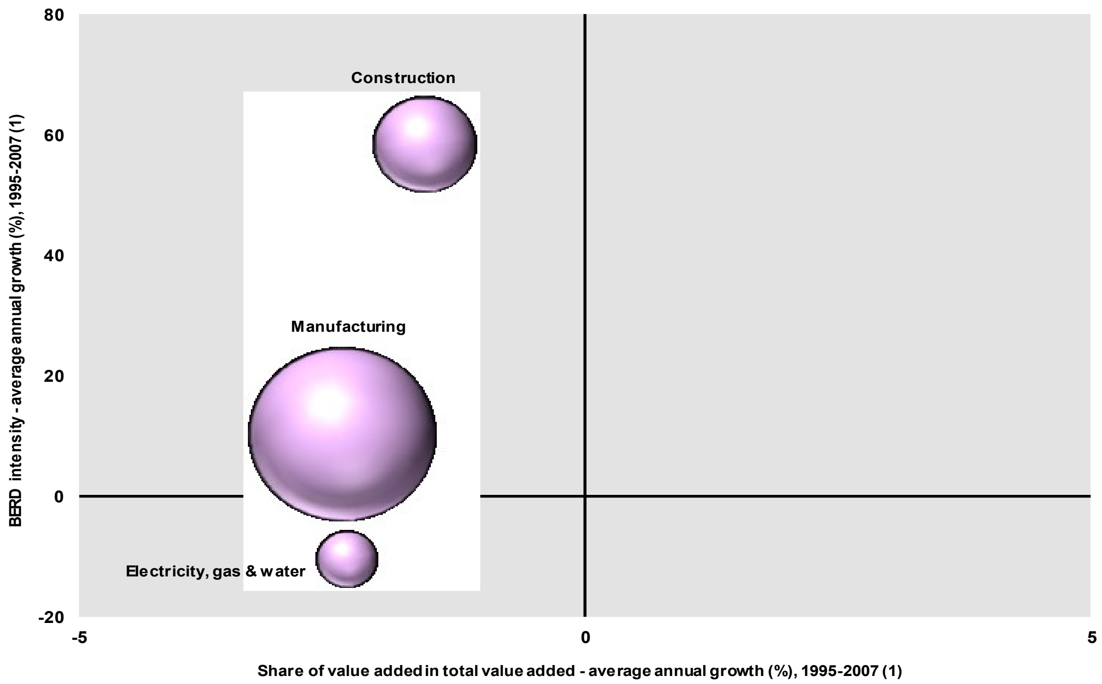
A similar approach will probably also be used in relation to university research institutions based on a protocol between the Ministry of Development and TUBITAK. Under this new protocol, a more efficient utilization and sustainability of existing and future Higher Education Research Centers will be ensured by a classification based on the measurement, monitoring and evaluation of their performances.
Furthermore, a temporary inter-ministerial coordination board including the participation of related governmental bodies has been set up to review all R&D, innovation and entrepreneurship support mechanisms in Turkey with a view to ensuring a target oriented approach.

Fostering and diffusing S&T awareness in society are among the areas which are under the auspices of the Prime Minister. It has been decided to work in close cooperation with local authorities to establish science centers, featuring interactive exhibits that encourage children and young people to experiment and explore, in each metropolis by the year 2016 and in each city by the year 2023.
The decrees adopted at the 24th meeting of BTYK which are focused on furthering the development of human resources for STI can be considered as complementary initiatives to the National Science and Technology Human Resources and Action Plan (2011-2016). These decrees strengthen the linkage between the Action Plan and education policies, as their main purpose is to improve the quality of the education system in Turkey by conducting educational assessment studies, developing digital course contents for primary-secondary education and also higher education, revising teaching programmes to enable students to acquire core competencies more efficiently, restructuring scholarship programs for graduate students to study abroad, and organizing science fairs for primary and secondary school students.

Upgrading the manufacturing sector through research and technologies

The graph below illustrates the upgrading of knowledge in different manufacturing industries. The position on the horizontal axis illustrates the changing weight of each industry sector in value added over the period. The general trend to the left-hand side reflects the decrease of manufacturing in the overall economy. The sectors above the x-axis are sectors whose research intensity has increased over time. The size of the bubble represents the share of the sector (in value added) in manufacturing (for all sectors presented on the graph). The red-coloured sectors are high-tech or medium-high-tech sectors.

Turkey - Share of value added versus BERD intensity - average annual growth, 1995-2007



Source: DG Research and Innovation - Economic Analysis unit
Data: Eurostat
Note: (1) 'Construction': 1997-2007.

The graph above illustrates that in Turkey,as in many other countries, the share of value added of manufacturing industries is tending to decrease due to the increase of services in the overall economy (as illustrated by a leftward shift in the graph above).

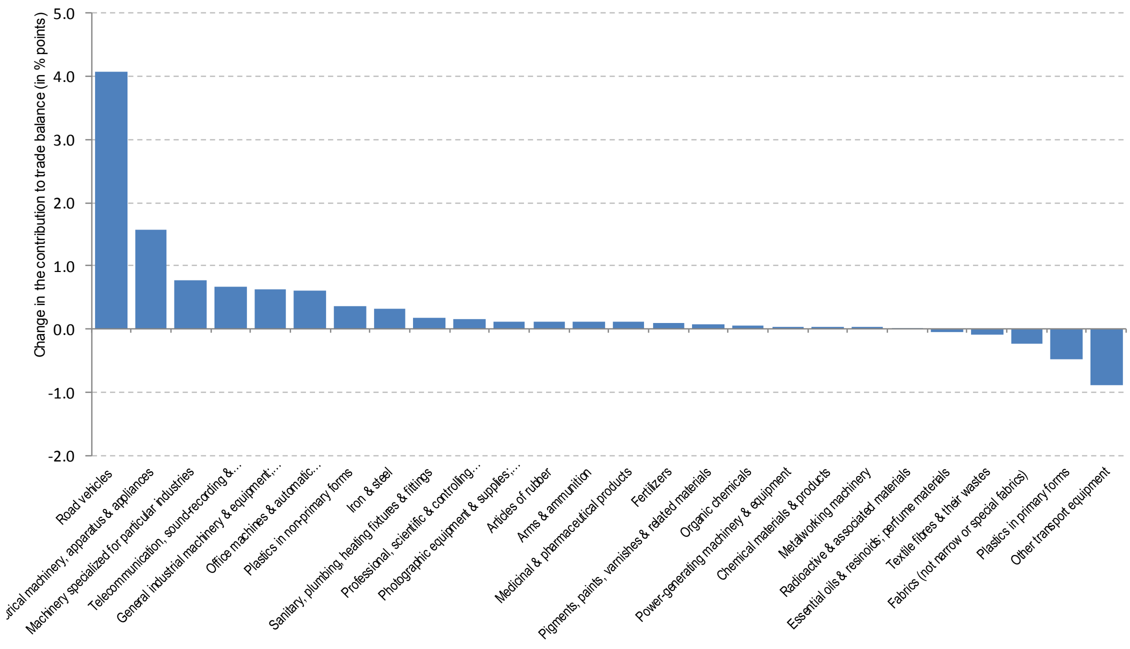
The three major industry sectors have seen their shares in the Turkish economy decrease over the period 1995-2007. However manufacturing and construction are moving towards more research intensive activities as shown by increases in business R&D intensity (business expenditure on R&D as % of value added) for these sectors. Turkey has four companies in the 2011 EU Industrial R&D Scoreboard - companies with a considerable level of R&D expenditure in the fields of general industrials, automobiles and parts, and leisure goods.

Turkey has strengths in medium–high technology manufacturing industries and knowledge services and is fast becoming Eurasia´s production base for medium–high and high-technology products. The aim of UBTYS 2011-2016 is to strengthen national R&D and innovation capacities in order to upgrade the industrial structure towards high–technology industries.

Competitiveness in global demand and markets

Investment in knowledge, technology-intensive clusters, innovation and the upgrading of the manufacturing sector are determinants of a country's competitiveness in global export markets. A positive contribution of high-tech and medium-tech products to the trade balance is an indication of specialisation and competitiveness in these products.

Evolution of the contribution of high-tech and medium-tech products to the trade balance for Turkey between 2000 and 2011



Source: DG Research and Innovation - Economic Analysis unit
Data: COMTRADE
Notes: "Textile fibres & their wastes" refers only to the following 3-digits sub-divisions: 266 and 267.
"Organic chemicals" refers only to the following 3-digits sub-divisions: 512 and 513.
"Essential oils & resinoids; perfume materials" refers only to the following 3-digits sub-divisions: 553 and 554. "Chemical materials & products" refers only to the following 3-digits sub-divisions: 591, 593, 597 and 598. "Iron & steel" refers only to the following 3-digits sub-divisions: 671, 672 and 679.
"Metalworking machinery" refers only to the following 3-digits sub-divisions: 731, 733 and 737.

The overall contribution of high-tech and medium-tech products to Turkey's trade balance was negative for each year over the last decade. Nevertheless, as the graph above illustrates several high-tech and medium-tech industries have improved their contributions to the Turkish trade balance, in particular road vehicles, electrical machinery, apparatus and appliances and machinery specialized for particular industries.

On other hand, industries with the biggest decreases in their contributions to the trade balance are power-generating machinery and equipment, plastics in primary forms and medical and pharmaceutical products, indicating a possible relative decline in world competitiveness.

Total factor productivity is growing strongly in Turkey, and so is the employment rate. Clear progress is also visible in R&D intensity and in the share of population aged 30-34 having successfully completed tertiary education. However, the overall values are still at a low level. Greenhouse gas emissions have increased over the last decade, despite some improvements in patenting in environment-related technologies. Patenting in health-related technologies has also grown, but from a very modest level.

Key indicators for Turkey[9]

TURKEY	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average annual growth [1] (%)	EU average [2]
ENABLERS															
Investment in knowledge															
New doctoral graduates (ISCED 6) per thousand population aged 25-34	0.19	0.17	0.21	0.23	0.21	0.22	0.20	:	0.31	0.34	0.38	:	:	7.3	*1.69*
Business enterprise expenditure on R&D (BERD) as % of GDP	0.16	0.18	0.15	0.11	0.13	0.20	0.21	0.30	0.32	0.34	0.36	:	:	8.4	*1.26*
Public expenditure on R&D (GOVERD + HERD) as % of GDP	0.32	0.36	0.38	0.37	0.39	0.39	0.37	0.42	0.40	0.51	0.48	:	:	4.3	*0.74*
Venture Capital as % of GDP	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
S&T excellence and cooperation															
Composite indicator of research excellence	:	:	:	:	:	12.2	:	:	:	:	13.8	:	:	2.5	47.9
Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country	3.6	3.4	3.8	3.8	4.7	5.0	5.5	6.6	6.7	:	:	:	:	8.2	10.9
International scientific co-publications per million population	18	17	22	33	40	42	45	52 [3]	56	62	66	71	:	7.9	300
Public-private scientific co-publications per million population	:	:	:	:	:	:	:	2	2	2	2	2	:	-0.7	53
FIRM ACTIVITIES AND IMPACT															
Innovation contributing to international competitiveness															
PCT patent applications per billion GDP in current PPS€	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6	:	:	:	14.9	3.9
License and patent revenues from abroad as % of GDP	:	:	:	:	:	:	:	0.00	0.00	0.00	0.00	:	:	:	0.58
Sales of new to market and new to firm innovations as % of turnover	:	:	:	:	:	:	15.8	:	:	:	:	:	:	:	14.4
Knowledge-intensive services exports as % total service exports	:	:	:	:	8.2	14.1	13.9	16.6	18.7	18.8	21.3	:	:	17.3	45.1
Contribution of high-tech and medium-tech products to the trade balance as % of total exports plus imports of products	-10.66	-7.79	-6.74	-6.09	-5.84	-4.79	-2.94	-1.95	-0.82	-3.88	-2.83	-2.22	:	-	4,20 [4]
Growth of total factor productivity (total economy) - 2000 = 100	100	93	98	102	112	117	120	:	:	:	:	:	:	20 [5]	103
Factors for structural change and addressing societal challenges															
Composite indicator of structural change	17.0	:	:	:	:	12.9	:	:	:	:	18.6	:	:	0.9	48.7
Employment in knowledge-intensive activities (manufacturing and business services) as % of total employment aged 15-64	:	:	:	:	:	:	:	:	:	4.8	4.8	4.7	:	-1.2	13.6
SMEs introducing product or process innovations as % of SMEs	:	:	:	:	:	:	29.5	:	:	:	:	:	:	:	38.4
Environment-related technologies - patent applications to the EPO per billion GDP in current PPS€	0.004	0.002	0.01	0.004	0.01	0.01	0.01	0.01	0.01	:	:	:	:	17.5	0.39
Health-related technologies - patent applications to the EPO per billion GDP in current PPS€	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.02	:	:	:	:	10.9	0.52
EUROPE 2020 OBJECTIVES FOR GROWTH, JOBS AND SOCIETAL CHALLENGES															
Employment rate of the population aged 20-64 (%)	:	:	:	:	:	:	48.2	48.2	48.4	47.8	50.0	52.2	:	1.6	68.6
R&D Intensity (GERD as % of GDP)	0.48	0.54	0.53	0.48	0.52	0.59	0.58	0.72	0.73	0.85	0.84	:	:	5.8	*2.03*
Greenhouse gas emissions - 1990 = 100	159	149	153	162	167	176	187	203	196	198	:	:	:	39 [6]	85
Share of renewable energy in gross final energy consumption (%)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Share of population aged 30-34 who have successfully completed tertiary education (%)	:	:	:	:	:	:	11.9	12.3	13.0	14.7	15.5	16.3	:	6.5	34.6
Share of population at risk of poverty or social exclusion (%)	:	:	:	:	:	:	72.4	:	:	:	:	:	:	:	*24.2*

Source: DG Research and Innovation - Economic Analysis Unit
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 2000-2012.
(2) EU average for the latest available year.
(3) Break in series between 2007 and the previous years. Average annual growth refers to 2007-2011.
(4) EU is the weighted average of the values for the Member States.
(5) The value is the difference between 2006 and 2000.
(6) The value is the difference between 2009 and 2000. A negative value means lower emissions.
(7) Values in italics are estimated or provisional.

[9] According to data provide by Turkish Government, values for some indicators are as follows:
- BERD as % of GDP increased from 0.16 in 2000 to 0.36 in 2010 with an average annual growth rate of 10.7
- GERD as % of GDP increased from 0.48 in 2000 to 0.84 in 2010 with an average annual growth rate of 6.2
- In 2010 the average of SMEs introducing products or process innovations was 32.6%

Methodological Notes

Symbols and abbreviations

Country codes

BE	Belgium	SE	Sweden
BG	Bulgaria	UK	United Kingdom
CZ	Czech Republic	EU	European Union
DK	Denmark	IS	Iceland
DE	Germany	LI	Liechtenstein
IE	Ireland	NO	Norway
EL	Greece	CH	Switzerland
ES	Spain	HR	Croatia
FR	France	MK	The former Yugoslav Republic of Macedonia
IT	Italy	TR	Turkey
CY	Cyprus	IL	Israel
LV	Latvia	ERA	European Research Area
LT	Lithuania	US	United States
LU	Luxembourg	JP	Japan
HU	Hungary	CN	China
MT	Malta	KR	South Korea
NL	Netherlands	IN	India
AT	Austria	TW	Chinese Taipei
PL	Poland	SG	Singapore
PT	Portugal	RU	Russian Federation
RO	Romania	AU	Australia
SI	Slovenia	CA	Canada
SK	Slovakia	ZA	South Africa
FI	Finland	BR	Brazil
		RoW	Rest of the World

Other abbreviations

: ‘not available’

- ‘not applicable’ or ‘real zero’ or ‘zero by default’

Overall performance in research, innovation and competitiveness

R&D Intensity
Definition: Gross Domestic Expenditure on R&D (GERD) as % of Gross Domestic Product (GDP)
Sources: Eurostat, OECD

Gross Domestic Product (GDP)
Definition: Gross domestic product (GDP) data have been compiled in accordance with the European System of Accounts (ESA 1995). Since 2005, GDP has been revised upwards for the majority of EU Member States following the allocation of FISIM (Financial Intermediation Services Indirectly Measured) to user sectors. This has resulted in a downward revision of R&D intensity for individual Member States and for the EU.
Source: Eurostat

Gross Domestic Expenditure on R&D
Definition: Gross domestic expenditure on R&D (GERD) is defined according to the OECD Frascati Manual definition. GERD can be broken down by four sectors of performance:
(i) Business Enterprise Expenditure on R&D (BERD);
(ii) Government Intramural Expenditure on R&D (GOVERD);
(iii) Higher Education Expenditure on R&D (HERD);
(iv) Private non-Profit expenditure on R&D (PNPRD).
GERD can also be broken down by four sources of funding:
(i) Business Enterprise;
(ii) Government;
(iii) Other national sources;
(iv) Abroad.
Sources: Eurostat, OECD

Index of economic impact of innovation
The index is composed of five indicators of the Innovation Union Scoreboard 2013:
- *PCT patents applications per billion GDP (in PPS€)* - the number of PCT patent applications filed under the PCT, at international phase, designating the European Patent Office (EPO). Patent counts are based on the priority date, the inventor's country of residence and fractional counts. (Eurostat/OECD)
- *Employment in knowledge-intensive activities (manufacturing and services) as % of total employment* - number of employed persons in knowledge-intensive activities in business industries. Knowledge-intensive activities are defined, based on EU Labour Force Survey data, as all NACE Rev.2 industries at 2-digit level where at least 33% of employment has a higher education degree (ISCED5 or ISCED6) (Eurostat)
- *Contribution of medium and high-tech product exports to trade balance* – see below
- *Sales of new to market and new to firm innovations as % of turnover* - sum of total turnover of new or significantly improved products, either new to the firm or new to the market, for all enterprises (Eurostat - Community Innovation Survey)
- *Knowledge-intensive services exports as % total service exports* - exports of knowledge-intensive services are measured by the sum of credits in EBOPS (Extended Balance of Payments Services Classification) 207, 208, 211, 212, 218, 228, 229, 245, 253, 260, 263, 272, 274, 278, 279, 280 and 284 (UN/Eurostat)

Source: Innovation Union Scoreboard 2013

Hot-spots clusters in key technologies
Based on the total number of patent applications and patents granted by the EPO by NUTS2 regions by inventor's region of residence and by applicant's region, by priority year, period (2001-2010) there

were developed clusters for key technologies: 0-25% - low innovative cluster; 26-50% - medium-low innovative cluster; 51-75% - medium-high innovative cluster and 76-100% - high innovative cluster.

Excellence in research (S&T)

Definition: It is a composite indicator developed in order to measure the research excellence in Europe, meaning the effects of European and National policies on the modernization of research institutions, the vitality of the research environment and the quality of research outputs in both basic and applied research. This core indicator is a composite of four variables:

- The share of highly cited publications in all publications where at least one of the authors has an affiliation in a given country (10% most highly cited publications considered, full counting method; source: Science Metrix calculations using Scopus data)
- Number of top scientific universities and public research organizations in a country divided by million population (world top 250 scientific universities and top 50 public research organizations considered; source: Leiden Ranking and Scimago Institutional Ranking)
- Patent applications per million population (PCT patent applications by country of inventor, 3-year moving average; source: OECD, Eurostat)
- Total value of ERC grants received divided by public R&D performed by the higher education and government sectors (transformed by using the natural logarithm, multi-year projects divided equally over time; source: DG-RTD, ERC)

The value of the composite indicator (a country score) is a geometric average of the four variables normalized between 10 and 100 using the min-max method and taking into consideration the two time points simultaneously.

Source: Group of Research and Innovation Union Impact, RTD-JRC (Ispra): Composite Indicator of Research Excellence, 2012.

Knowledge-intensity of the economy (Structural change of economy)

Definition: Compositional structural change indicators measure changes in the actual sectoral composition of the economy in terms of production and employment, business research and development (R&D), high-tech exports and technological specialization and foreign direct investments. Changes may affect the linkages among sectors and technologies, and influence the changes of the international advantages of countries.

Eight compositional structural change indicators have been identified and organized into five dimensions:

- The R&D dimension measures the size of business R&D (as a % of GDP) and the size of the R&D services sector in the economy (in terms of total value added; source: WIIW calculations using OECD, Eurostat, WIOD and national sources)
- The skills dimension measures changing skills and occupation in terms of the share of persons employed in knowledge intensive activities (both in manufacturing and service sectors considered where on average at least a third of the employees have tertiary graduates; source: Eurostat)
- The sectoral specialization dimension captures the relative share of knowledge intensive activities (in terms of value added; source WIIW calculations using OECD, Eurostat, WIOD and national sources)
- The international specialization dimension captures the share of knowledge economy through technological (patents) and export specialization (revealed technological and competitive advantage) and

- The internationalization dimension refers to the changing international competitiveness of a country in terms of attracting and diffusing foreign direct investment (inward and outward foreign direct investments).

The eight indicators in the five pillars have been normalized between 10 and 100 using the min-max method and taking into consideration three time points simultaneously. The five pillars have also been aggregated to a single composite indicator of structural change using the geometric average to provide an overall measure of country progress in this area.
Source: Group of Research on the impact of the Innovation Union (GRIU), RTD-JRC/IPSC Ispra): Composite Indicators measuring structural change, monitoring the progress towards a more knowledge-intensive economy in Europe, 2011.

Contribution of High-Tech and Medium-Tech manufacturing to trade balance
Definition: The "contribution to the trade balance" is the difference between observed industry trade balance and the theoretical trade balance.
By trade balance we understand the difference between the level of exports and the level of imports at a particular industry/sector.
The contribution to the trade balance is given by the formula:

$$\left[(X_i - M_i) - (X - M)\frac{(X_i + M_i)}{(X + M)}\right] / (X + M) * 100$$

where

$(X_i - M_i)$	=	observed industry trade balance
$(X - M)\frac{(X_i + M_i)}{(X + M)}$	=	theoretical trade balance

If there is no comparative advantage or disadvantage for any industry i*, a country's total trade balance (surplus or deficit) should be distributed across industries according to their share in the total trade. A positive value for an industry indicates structural surplus and a negative value a structural deficit.*

The HT & M-HT trade balance include of the following SITC Rev.3 products: 266, 267, 512, 513, 525, 533, 54, 553, 554, 562, 57, 58, 591, 593, 597, 598, 629, 653, 671, 672, 679, 71, 72, 731, 733, 737, 74, 751, 752, 759, 76, 77, 78, 79, 812, 87, 88, 891.
Source: OECD (*Moving Up the Value Chain: Staying Competitive in the Global Economy*, 2007), UN (Comtrade), RTD - Economic Analysis Unit

Investing in knowledge

Public expenditure on R&D
Definition: For the purposes of this publication, Public expenditure on R&D is defined as Government Intramural Expenditure on R&D (GOVERD) plus Higher Education Expenditure on R&D (HERD).
Sources: Eurostat, OECD

Private expenditure on R&D
Definition: For the purposes of this publication, Private expenditure on R&D is defined as Business Enterprise Expenditure on R&D (BERD) plus Private non-Profit expenditure on R&D (PNPRD).
Sources: Eurostat, OECD

BERD Intensity
Definition: Business Enterprise Expenditure on R&D (BERD) as % of Gross Domestic Product (GDP)
Sources: Eurostat, OECD

Public sector R&D Intensity
Definition: Public expenditure on R&D (GOVERD plus HERD) as % of GDP.
Sources: Eurostat, OECD

Government budget for R&D
Definition: The government budget for R&D is defined as government budget appropriations or outlays for R&D (GBAORD), according to the OECD Frascati Manual definition. The data are based on information obtained from central government statistics and are broken down by socio-economic objectives in accordance with the nomenclature for the analysis and comparison of scientific programmes and budgets (NABS).
Source: Eurostat

Structural Funds
Definition: Structural Funds are funds intended to facilitate structural adjustment of specific sectors, regions, or combinations of both, in the European Union. Structural Funds for RTDI include data from sectors involving research and development, technological innovation, entrepreneurship, innovative ICT and human capital.
Source: DG REGIO.

Purchasing Power Standards (PPS)
Definition: Financial aggregates are sometimes expressed in Purchasing Power Standards (PPS), rather than in euro based on exchange rates. PPS are based on comparisons of the prices of representative and comparable goods or services in different countries in different currencies on a specific date. The calculations on R&D investments in real terms are based on constant 2000 PPS.
Source: Eurostat

Value Added
Definition: Value added is current gross value added measured at producer prices or at basic prices, depending on the valuation used in the national accounts. It represents the contribution of each industry to GDP.
Sources: Eurostat, OECD

Venture Capital
Definition: Venture Capital investment is defined as private equity being raised for investment in companies. For data between 2000 and 2006, management buyouts, management buy-ins, and venture purchase of quoted shares are excluded. Venture Capital includes early stage (seed + start-up) and expansion and replacement capital. As of 2007 data are broken into the following stages: Seed; Start-up; Later stage venture; Growth; Rescue/Turnaround; Replacement capital; Buyouts.
Source: Eurostat, EVCA

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

Framework Programme
Definition: The Framework Programmes for Research and Technological Development are the EU's main instruments for supporting collaborative research, development and innovation in science, engineering and technology. Participation is on an internationally collaborative basis and must involve European partners. The first Framework Programme was launched in 1984. The seventh Framework Programme (FP7) covers the period 2007-2013.
Source*:* DG Research and Innovation

Higher Education
ISCED (International Standard Classification of Education)
ISCED 5: Tertiary education (first stage) not leading directly to an advanced research qualification.
ISCED 5A: Tertiary education programmes with academic orientation.
ISCED 5B: Tertiary education programmes with occupation orientation.
ISCED 6: Tertiary education (second stage) leading to an advanced research qualification (PhD or doctorate).

Human Resources for Science and Technology (HRST), R&D personnel and researchers
The Canberra Manual proposes a definition of HRST as persons who either have higher education or persons who are employed in positions that normally require such education. HRST are people who fulfil one or other of the following conditions:

a) Successfully completed education at the third level in an S&T field of study (HRSTE - Education);
b) Not formally qualified as above, but employed in a S&T occupation where the above qualifications are normally required (HRSTO - Occupation).

HRST Core (HRSTC) are people with both tertiary-level education and an S&T occupation. Scientists and engineers are defined as ISCO categories 21 (Physical, mathematical and engineering science professionals) and 22 (Life science and health professionals).

The Frascati Manual proposes the following definitions of R&D personnel and researchers:

- R&D personnel: "All persons employed directly on R&D should be counted, as well as those providing direct services such as R&D managers, administrators, and clerical staff." (p.92);
- Researchers: "Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned." (p.93). R&D may be the primary function of some persons or it may be a secondary function. It may also be a significant part-time activity.

Therefore, the measurement of personnel employed in R&D involves two exercises:

- measuring their number in headcounts (HC): the total number of persons who are mainly or partially employed in R&D is counted;
- measuring their R&D activities in full-time equivalence (FTE): the number of persons engaged in R&D is expressed in full-time equivalents on R&D activities (= person-years).

Public and Private sector researchers
Definition: For the purposes of this publication, Public sector researchers refer to researchers in the government and higher education sectors. Private sector researchers refer to researchers in the business enterprise and private non-profit sectors.
Source: Eurostat, OECD

Small and medium-size enterprises (SMEs)
Definition: Small and medium-size enterprises (SMEs) are defined as enterprises having fewer than 250 employees.
Sources: Eurostat, OECD

Licence and patent revenues from abroad
Definition: The export part of international transactions in royalties and license fees.
Source: Eurostat, TRADE

Patent Cooperation Treaty (PCT) Patents
Definitions: The Patent Cooperation Treaty (PCT) is an international treaty, administered by the World Intellectual Property Organization (WIPO), signed by 133 Paris Convention countries. The PCT makes it possible to seek patent protection for an invention simultaneously in each of a large number of countries by filing a single "international" patent application instead of filing several separate national or regional applications. Indicators based on PCT applications are relatively free from the "home advantage" bias (proportionate to their inventive activity, domestic applicants tend to

file more patents in their home country than non-resident applicants). The granting of patents remains under the control of the national or regional patent offices. The PCT patents considered are 'PCT patents, at international phase, designating the European Patent Office'. The country of origin is defined as the country of the inventor. If one application has more than one inventor, the application is divided equally among all of them and subsequently among their countries of residence, thus avoiding double counting.

"PCT is an option for possible future patenting, that provides the applicant with a further delay before deciding to apply or not. The delay can be 6 to 12 months. The relation between the PCT option and patent value is not predictable (Grupp and Schmoch, 1999). The PCT process provides the advantage of a longer investigation of the technological potential of the invention, and in case of a negative assessment, the application can be withdrawn before entering into expensive regional (EPO) phase. Having passed this test, the PCT applications that are continued towards entering the regional phase are likely the ones of higher value. However, the argument can be reversed in the way that inventions with unclear market potential are passed through the PCT route, whereas those with an unquestionable potential are directly applied at the regional phase, since the direct path is cheaper." (Guellec & van Pottelsberghe, 2000).

Societal challenges patents comprise climate change mitigation patents and health technology patents.
Climate change mitigation patents comprise patents for renewable energy, electric and hybrid vehicles and energy efficiency in buildings and lighting.
Health technology patents comprise patents for medical technologies and pharmaceuticals.

Environment-related technologies
Definition: patent applications to EPO per billion GDP in current PPS€
The environment-related technologies refer to the following thematic areas:

A. General environmental management
B. Energy generation from renewable and non-fossil sources
C. Combustion technologies with mitigation potential
D. Technologies specific to climate change mitigation
E. Technologies with potential or indirect contribution to emissions mitigation
F. Emissions abatement and fuel efficiency in transportation
G. Energy efficiency in buildings and lighting

Health-related technologies
Definition: patent applications to the EPO per billion GDP in current PPS€
The health-related technologies refer to medical technologies and pharmaceuticals: surgery, dentistry, prostheses, transport / accommodation for patients, physical therapy devices, containers, medical preparations, sterilization, media devices, electrotherapy, chemical compounds.
Source: OECD

Community Trademark System (CTM)
Definition: The Community trade mark system allows the uniform identification of products and services by enterprises throughout the EU. A unique procedure applied by the Office for Harmonization in the Internal Market (OHIM) allows them to register trademarks which will benefit from unitary protection and be fully applicable in every part of the Community. The CTM system is unitary in character. A CTM registration is enforceable in all member states.
Source: OHIM

Country groupings – methodology
In order to create homogeneous groups of similar research and innovation systems in the European Research Area, a principal components analysis (PCA) on nineteen variables characterising research and innovation systems was carried out. The values of the variables as were obtained for 2008 or the latest available year from Eurostat and the OECD and included data for all 27 EU Member States as well as for Norway, Switzerland, Croatia, Turkey and Israel. Table 1 presents the main values of the

different factors accruing from the PCA. The first principal component explains 49.7% of the variance-. The second principal component explains 12.4% of the variance and together, the two principal components manage to explain above 62% of the total variance.

Table 1: Results of the Principal Component Analysis

	Eigenvalue	Proportion	Cumulative
Factor 1	9.44203858	0.4969	0.4969
Factor 2	2.35266703	0.1238	0.6208
Factor 3	1.96210394	0.1033	0.724
Factor 4	1.23153877	0.0648	0.7889
Factor 5	1.01292575	0.0533	0.8422

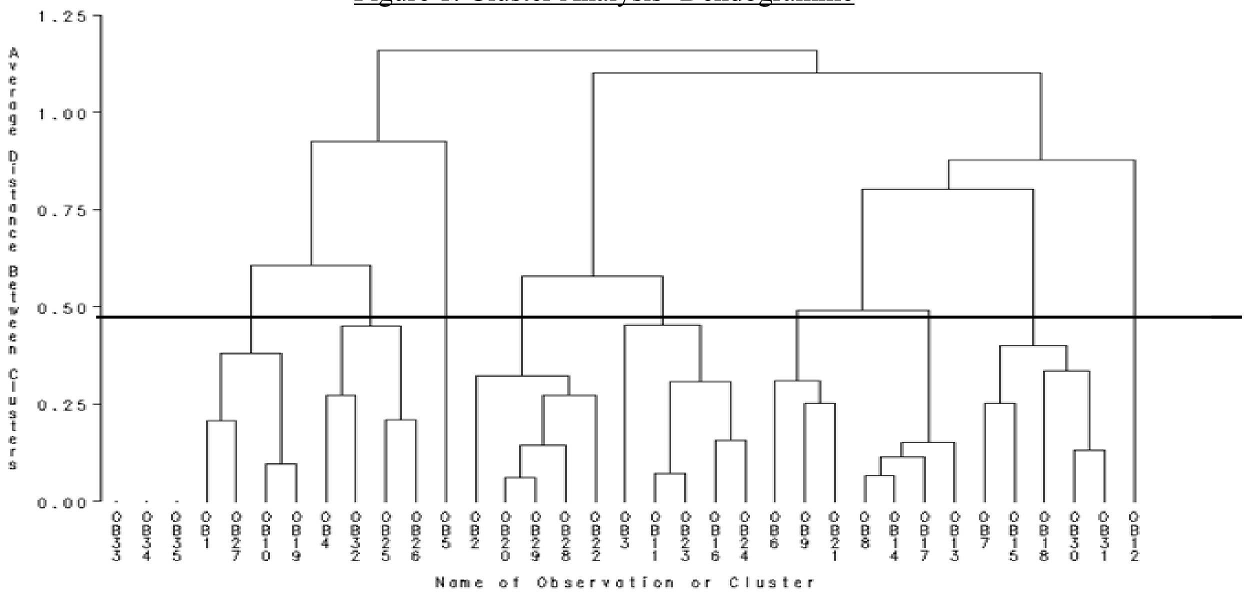
Table 2 presents the correlation matrix between the main components and the individual variables that can help interpreting the nature of these factors. To a great extent, Component 1 corresponds to the economic and technological development of the country. As shown by the correlation matrix, this factor is closely related with per capita GDP, investments in R&D, HRST, research excellence, patents and levels of skills and employment. The second component represents the sectoral specialisation, as it is shown by the coordinates of industrial employment and employment in medium-high and high tech manufactures.

Table 2: Correlation matrix between the principal components and the individual variables

	Factor1	Factor2	Factor3	Factor4	Factor5
GERD as % of GDP	**0.88045**	0.34761	0.1694	0.09631	-0.06329
BERD as % of GDP	**0.86653**	0.37803	0.0769	0.10575	-0.03081
GOVERD as % of GDP	0.07583	0.26135	0.55564	-0.44498	0.49791
HERD as % of GDP	**0.77148**	0.08173	0.20893	0.25351	-0.41071
HRST as % of total population	**0.84051**	-0.32415	0.24602	-0.09118	0.16476
EPO patent applications per million population	**0.85114**	0.24681	-0.1413	0.04174	-0.02927
EPO high-tech patents per million population	**0.82359**	0.28775	-0.08296	0.01004	-0.02086
Population aged 25-64 having completed tertiary education	**0.76955**	-0.39397	0.23008	-0.10595	0.04449
Participation in life-long learning	**0.8845**	-0.00273	0.21098	0.24563	-0.03637
Employment in primary sectors	-0.63319	0.01507	0.40398	-0.07697	-0.32419
Employment in industrial sectors	-0.5726	**0.60788**	0.22957	0.32484	0.2158
Employment in business and financial sectors	0.59243	0.03313	-0.52275	-0.38809	0.16055
Employment in high-tech and medium-high-tech manufacturing	-0.07533	**0.88354**	0.0989	0.10371	0.24159
Employment in knowledge-intensive services (KIS)	**0.90799**	-0.08451	-0.00034	0.15404	0.08702
Population density	-0.05817	-0.08058	**-0.69541**	0.49535	0.29596
Employment rate	**0.70931**	-0.29551	**0.44466**	0.10663	0.07883
GDP per capita	**0.75882**	-0.09803	-0.28462	-0.27672	0.20282
GDP natural logarithm	0.17245	0.584	-0.29413	-0.48494	-0.41219
Research excellence (highly-cited scientific publications)	**0.89965**	0.08266	-0.2061	0.04531	-0.10682

Based on the findings of the PCA, a hierarchical cluster analysis is carried out in order to gather the regions in homogeneous groups. Figure 1 presents the dendogramme presenting the different groups as well as the bar separating the different country groups.

Figure 1: Cluster Analysis- Dendogramme



Source: RTD – Economic Analysis Unit (2011)

Scientific and technological strengths

The NUTS classification
Definition: The Nomenclature of Statistical Territorial Units (NUTS) is a single coherent for dividing up the European Union's territory in order to produce regional statistics for the Community. NUTS subdivides each Member State into a whole number of regions at NUTS 1 level. Each of these is then subdivided into regions at NUTS level 2 and these in turn into regions at NUTS level 3.
Source: Eurostat

Scientific Publications
Definition: Publications are research articles, reviews, notes and letters published in referenced journals which are included in the Scopus database of Elsevier. A full counting method was used at the country level. However, for the EU aggregate, double counts of multiple occurrences of EU Member States in the same record were excluded.
Source: Scopus (Elsevier); treatments and calculations: Science Metrix

Average of Relative Citations (ARC)
The ARC is an indicator of the scientific impact of papers produced by a given entity (e.g., the world, a country, a NUTS2 region, an institution) relative to the world average (i.e., the expected number of citations). The number of citations received by each publication is counted for the year in which it was published and for the three subsequent years. For papers published in 2000, for example, citations received in 2000, 2001, 2002 and 2003 are counted.
To account for different citation patterns across fields and subfields of science (e.g., there are more citations in biomedical research than in mathematics), each publication's citation count is divided by the average citation count of all publications of the corresponding document type (i.e., a review would be compared to other reviews, whereas an article would be compared to other articles) that were published the same year in the same subfield to obtain a Relative Citation count (RC). The ARC of a given entity is the average of the RCs of the papers belonging to it. An ARC value above 1 means that a given entity is cited more frequently than the world average, while a value below 1 means the reverse. The ARC is computed for the 2000-2006 period only since publications in 2007, 2008 and 2009 have incomplete citation windows.

Methodology of co-publication analysis
The methodology used for the co-publication analysis involved three types of analysis:
a) Single country publications cover co-publications that involve domestic partners only; this is the sum of all papers written by one or more authors from a given country (and non-nationals resident in that country). Although the literature usually distinguishes between domestic single publications (including one or more authors belonging to the same institution) and domestic co-publications (i.e. authors within the same country but from different main organisations), for the aim of the current analysis the sum of the two categories have been used under the heading of "single country publications".
b) EU transnational co-publications refer to international co-publications which involve at least one author from an EU country. This category includes both co-publications by authors from at least two different EU Member States (as defined by research papers containing at least two authors' addresses in different countries) and co-publications between one or several authors from the EU together with at least one author from a country outside the EU.

c) Extra-EU co-publications is a sub-category of the broader EU transnational co-publications. It refers exclusively to international co-publications involving at least one EU author and at least one non-EU author, as defined by the authors' addresses in different countries.
An important methodological issue is the way in which a co-publication is quantified. The full counting method has been used in this report, meaning that a single international co-published paper is assigned to more than one country of scientific origin. If, for example, the authors' addresses signal three different countries in the EU, the publication is counted three times – once for each country mentioned. Therefore, in a matrix of co-publications between countries, the number of publications mentioned is not a completely accurate indicator of the number of publications being co-authored, but rather how often a country or region is involved in co-publications.

Public-Private co-publications
Definition: Number of public-private co-authored research publications. The private sector excludes the private medical and health sector.
Source: CWTS / Thomson Reuters

Scientific Specialisation
Definition: The relative scientific specialisation index (RCA) is calculated for 28 disciplines on the basis of publications from 2000-2002 and 2004-2006. The fields 'multidisciplinary' and 'social Sciences'' have been excluded. The formula used is the hyperbolic tangent function for the ratio of the share of a domain or discipline in a country compared to the share of the domain in the total for the world: $RCA_{ki} = 100 \times \tanh \ln \{(A_{ki}/\sum_i A_{ki})/(\sum_k A_{ki}/\sum_{ki} A_{ki})\}$, with A_{ki} indicating the number of publications of country k in the field i, whereby the field is defined by 28 scientific disciplines used in the classifications.
LN centres the data on zero and the hyperbolic tangent multiplied by 100 limits the RCA values to a range of +100 to -100. Scores below -20 are considered a significant under-specialisation in a given scientific field, scores between -20 and +20 are around field average and mean no significant (under-) specialisation, and scores above +20 mean a significant specialisation in a given field. The RCA indicator allows the assessment of the relative position of a field i in a country beyond any size effects. Neither the size of the field nor the size of the country has an impact on the outcome of this indicator. Therefore, it is possible to directly compare countries and fields.
Source: ISI, Science Citation Index; treatments and calculations: Fraunhofer ISI

Technology Categories
Definition: The four manufacturing industry technology categories are defined as follows (NACE Rev 1.1 codes are given in brackets):

(1) High-tech: office machinery and computers (30), radio, television and communication equipment and apparatus (32), medical, precision and optical instruments, watches and clocks (33), aircraft and spacecraft (35.3), pharmaceuticals, medicinal chemicals and botanical products (24.4).
(2) Medium-high-tech: machinery and equipment (29), electrical machinery and apparatus (31), motor vehicles, trailers and semi-trailers (34), other transport equipment (35) excluding building and repairing of ships and boats (35.1) and excluding aircraft and spacecraft (35.3), chemicals and chemical products (24) excluding pharmaceuticals, medicinal chemicals and botanical products (24.4).
(3) Medium-low-tech: coke, refined petroleum products and nuclear fuel (23), rubber and plastic products (25), non-metallic mineral products (26), basic metals (27), fabricated metal products (28), building and repairing of ships and boats (35.1).
(4) Low-tech: food products and beverages (15), tobacco products (16), textiles (17), wearing apparel; dressing and dyeing of fur (18), tanning and dressing of leather, manufacture of luggage, handbags, saddlery and harness (19), wood and products of wood and cork, except furniture (20), pulp, paper and paper products (21), publishing, printing and reproduction of recorded media (22), furniture and other manufacturing (36), recycling (37).

Technological Specialisation
Definition: The relative technological specialisation index (or RCA) is calculated for 19 technology domains on the basis of PCT patent applications (at the international phase, designating the EPO). The data were classified by earliest priority date and country of residence of the inventor.
The formula used is the hyperbolic tangent function for the ratio of the share of a domain in a country compared to the share of the domain in the total for the world: $RCA_{ki} = 100 \times \tanh \ln \{(A_{ki}/\sum_i A_{ki})/(\sum_k A_{ki}/\sum_{ki} A_{ki})\}$, with A_{ki} indicating the number of PCT patent applications (at international phase, designating the EPO) of country k in the field i.LN centres the data on zero and the hyperbolic tangent multiplied by 100 limits the RCA values to a range of +100 to -100. Scores below -20 are considered a significant under-specialisation in a given scientific domain, scores between -20 and +20 are around domain average and mean no significant (under-)specialisation, and scores above +20 mean a significant specialisation in a given domain. The RCA indicator allows the assessment of the relative position of a field i in a country beyond any size effects. Neither the size of the domain nor the size of the country has an impact on the outcome of this indicator. Therefore, it is possible to directly compare countries and domain.
Source: JRC-IPTS, based on EPO and WIPO data

Economic impact of innovation

Index of economic impact of innovation
See definition in section *Overall performance*.

EU Industrial R&D Investment Scoreboard
Definition: The EU Industrial R&D Investment Scoreboard presents information on the top 1000 EU companies and the 1000 non-EU companies. The Scoreboard includes data on R&D investment along with other economic and financial data. It is the source for the ICT Scoreboard, which provides data on the ICT companies with the largest R&D budgets globally.

Upgrading the manufacturing sector through research and technologies

Knowledge-Intensive Activities (KIAs)
Definition: Knowledge-Intensive Activities (KIAs) are defined as economic sectors in which more than 33% of the employed labour force has completed academic-oriented tertiary education (i.e. at ISCED 5 and 6 levels). They cover all sectors in the economy, including manufacturing and services sectors, and can be defined at two and three-digit levels of the statistical classification of economic activities.
Source: Eurostat

Knowledge-Intensive Services (KIS)
Definition: Knowledge-intensive services (KIS) includes the following sectors (NACE Rev.1.1 codes are given in brackets): water transport (61), air transport (62), post and telecommunications (64), financial intermediation, except insurance and pension funding (65), insurance and pension funding, except compulsory social security (66), activities auxiliary to financial intermediation (67), real estate activities (70), renting of machinery and equipment without operator and of personal and household goods (71), computer and related activities (72), research and development (73), other business activities (74), education (80), health and social work (85), recreational, cultural and sporting activities (92).
Source: OECD

Knowledge-Intensive Services exports
Definition: Exports of knowledge-intensive services are measured by the sum of credits in EBOPS (Extended Balance of Payments Services Classification) 207, 208, 211, 212, 218, 228, 229, 245, 253, 260, 263, 272, 274, 278, 279, 280, 284.
Source: UN

Competitiveness in global demand and markets

Contribution to trade balance
See definition in section *Overall performance*.

High-Tech and Medium-Tech manufacture
See definition in section *Overall performance*.