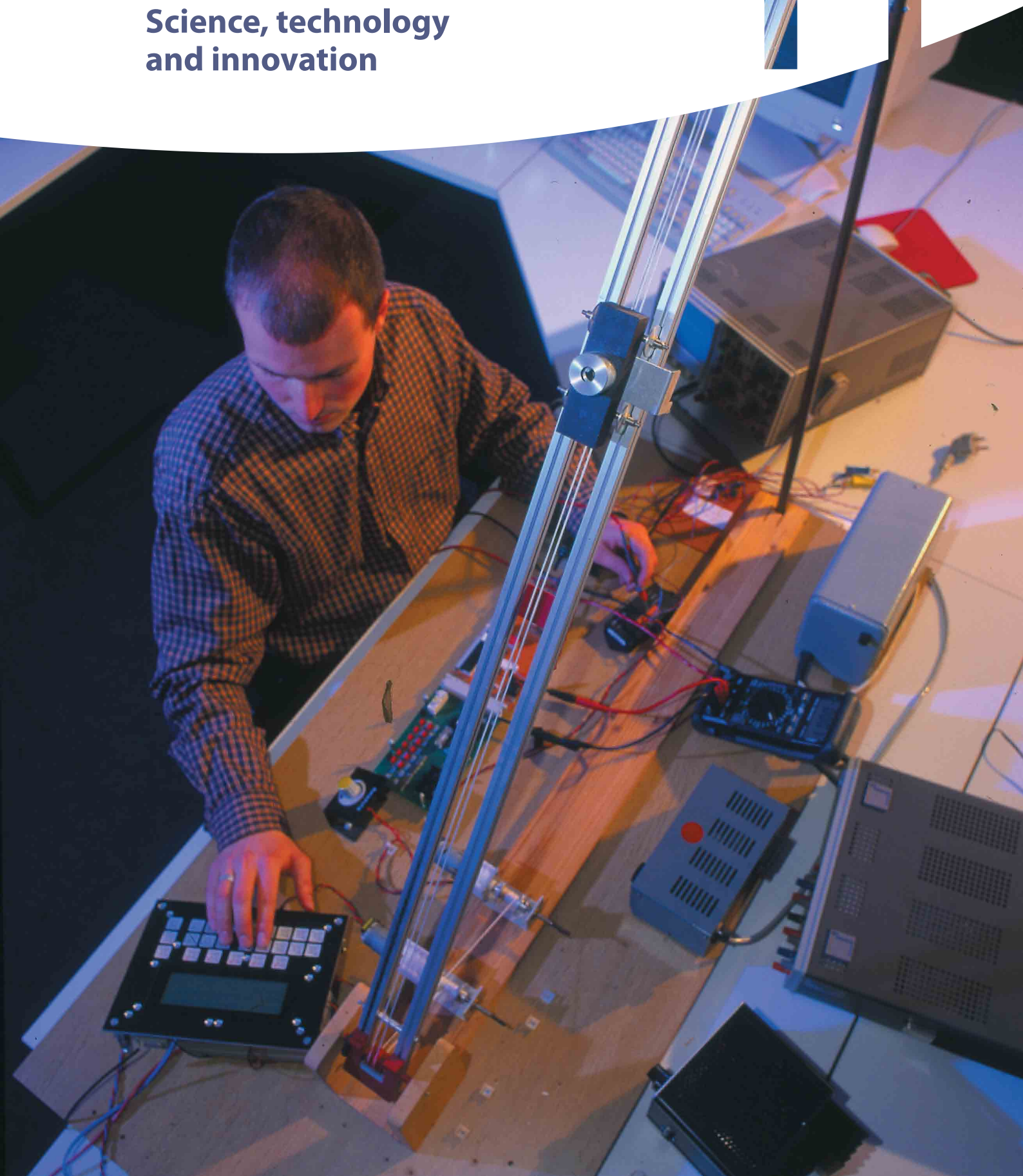
11

Science, technology and innovation



This chapter presents statistical information that illustrates regional developments for science and technology indicators within the European Union (EU). The domains covered are research and development (R & D), the number of researchers, human resources in science and technology (HRST), employment in high technology sectors and patent applications.

Main statistical findings

Research and development intensity

The EU-27 had an R & D intensity ratio of 2.01 % in 2009, in other words, expenditure on R & D was equivalent to 2.01 % of GDP. A total of 35 of the 266 EU regions shown in Map 11.1 had an R & D intensity above 3 % in 2009. As such, they exceeded the 3 % R & D intensity target set by the Barcelona Council in 2002 and maintained in the Europe 2020 strategy. Among these 35 regions, 11 were in Germany, eight in the United Kingdom, four in Sweden, three each in Denmark and Finland and two each in Belgium, France and Austria. Together these 35 regions accounted for 45.0 % of all R & D expenditure in the EU.

The German regions included a cluster of regions in south-western and south-eastern Germany: Rheinhessen-Pfalz, Stuttgart, Karlsruhe, Tübingen, Oberbayern, Mittelfranken and Darmstadt. These regions were also very important in absolute terms (the level rather than the intensity of R & D), as together they accounted for 13.4 % of total R & D expenditure in the EU in 2009. The four other German regions with R & D intensity above 3 %, from west to east, were Köln, Braunschweig (7.93 % R & D intensity — the most R & D-intensive region on the map), Berlin and Dresden; these four regions together contributed 5.2 % of total R & D expenditure in the EU.

The two Belgian regions were the Province/Provincie du Brabant Wallon, which was the second most R & D intensive region on the map, with a ratio equivalent to 7.6 % of GDP, and the neighbouring Province/Provincie Vlaams-Brabant; as well as a large industrial area around the Belgian capital, these regions include the university towns of Louvain-la-Neuve (which has a science park) and Leuven.

Ten of the most R & D-intensive regions in 2009 were located in the Nordic Member States, including the capital city regions of Denmark and Sweden; the third highest R & D intensity of all EU regions was recorded in the Finnish region of Pohjois-Suomi (6.58 %). The 10 regions in Nordic Member States with an R & D intensity above 3 % collectively contributed 9.3 % of total R & D expenditure in the EU.

The two most R & D-intensive regions in the United Kingdom in 2009 were Cheshire, in North West England (6.51 %), and East Anglia (5.59 % — this region includes the area around Cambridge). Together these two regions contributed around 2.0 % of total R & D expenditure in the EU. Apart from North Eastern Scotland (which is the main British region that supports the North Sea extraction of oil and gas), the other R & D-intensive regions in the United Kingdom were generally in southern England; together these contributed 3.9 % to total R & D expenditure in the EU. In France the highest R & D intensity was in Midi-Pyrénées (4.38 % — this region includes a cluster of R & D-intensive enterprises related to aerospace manufacturing, centred on Toulouse) ahead of the capital city region of Île de France (3.01 %). The level of R & D expenditure in these two regions was high, particularly in the Île de France region, which had the highest level of R & D expenditure among any of the NUTS level 2 regions in the EU; as a result these two French regions together contributed 8.5 % to total R & D expenditure in the EU. In Austria the most R & D-intensive regions were Steiermark (3.88 %) and Wien (3.95 %), with a combined contribution of 1.8 % to total R & D expenditure in the EU.

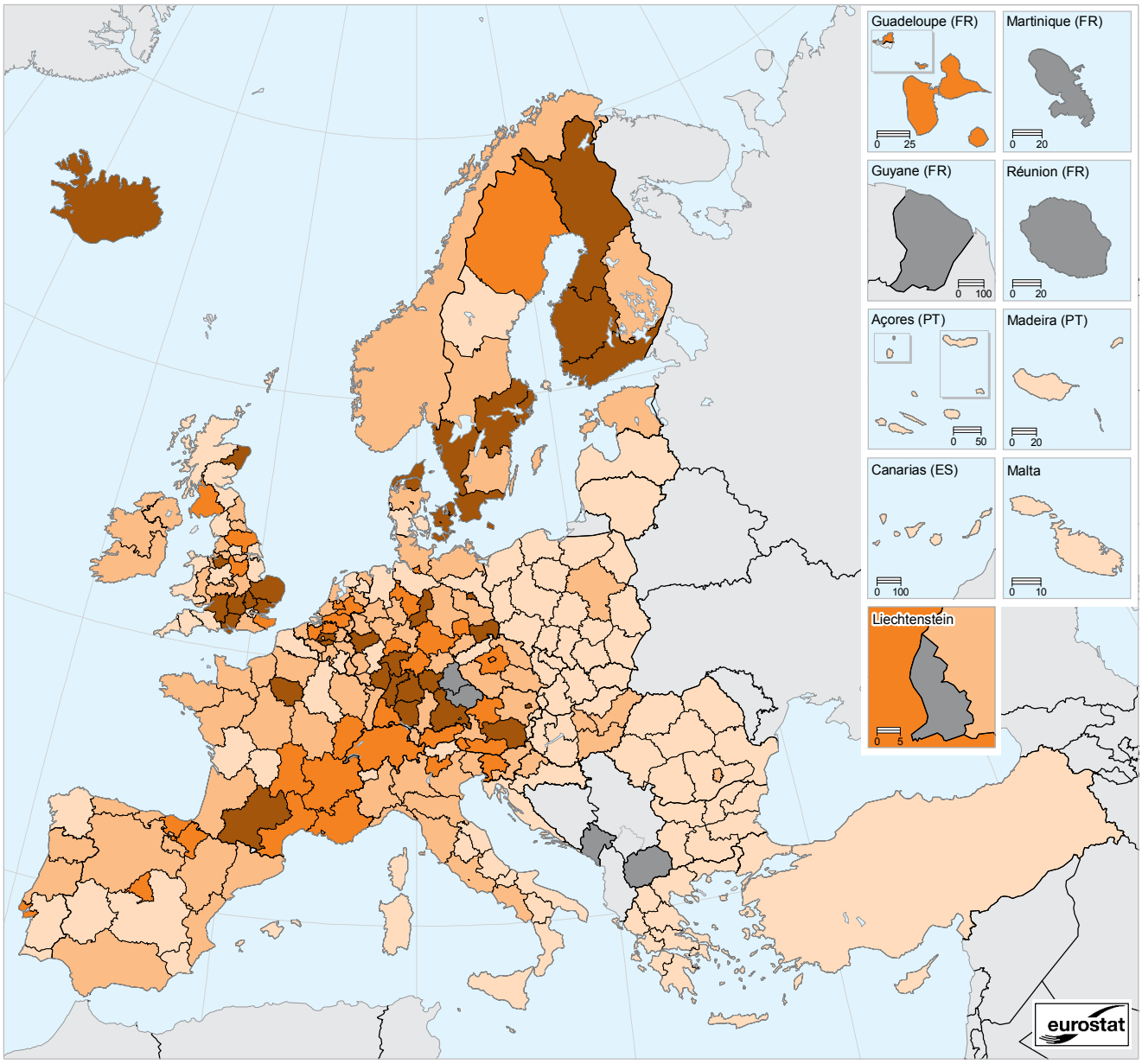
Among EFTA countries (no regional analysis is available) Iceland had an R & D intensity of 3.11 % and Norway of 1.80 % in 2009, while the rate in Switzerland was 2.99 % in 2008. Turkey (no regional analysis available) had an R & D intensity of 0.85 % in 2009, while the Croatian region of Sjeverozapadna Hrvatska had an R & D intensity of 1.54 %, far above the intensity recorded in the two other Croatian regions (also 2009).

Researchers

Map 11.2 provides an overview of the regional distribution of the share of researchers in total employment (measured as a headcount); the EU-27 average for this indicator was estimated to be 1.1 % in 2009. Researchers are directly employed on R & D activities and are defined as 'professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and in the management of the projects concerned'.

In many Member States the location of researchers was relatively concentrated, with a small number of regions recording a relatively high share of researchers in total employment far above the national average. The share of researchers among all persons employed was more than 2.0 % in 21 of the EU regions shown in Map 11.2. The Member States with several regions above this level included: Germany and the United Kingdom with four each, Belgium and Finland with three each and Denmark with two. Around two thirds of these regions with a high proportion of researchers also had high R & D intensity. Nevertheless, there were five regions where researchers accounted for more than 2.0 % of the workforce but where R & D intensity did not exceed 3 %: the capital city regions of Belgium, the Czech Republic, Portugal, Slovakia and the United Kingdom. More than 2.0 % of the workforce in Iceland and the Norwegian regions of Trøndelag and Oslo

Map 11.1: R & D intensity, by NUTS 2 regions, 2009 (1)
(R & D expenditure as a % share of GDP)



(R & D expenditure as a % share of GDP)

EU-27 = 2.01

- <= 1
- 1 – 2
- 2 – 3
- > 3
- Data not available

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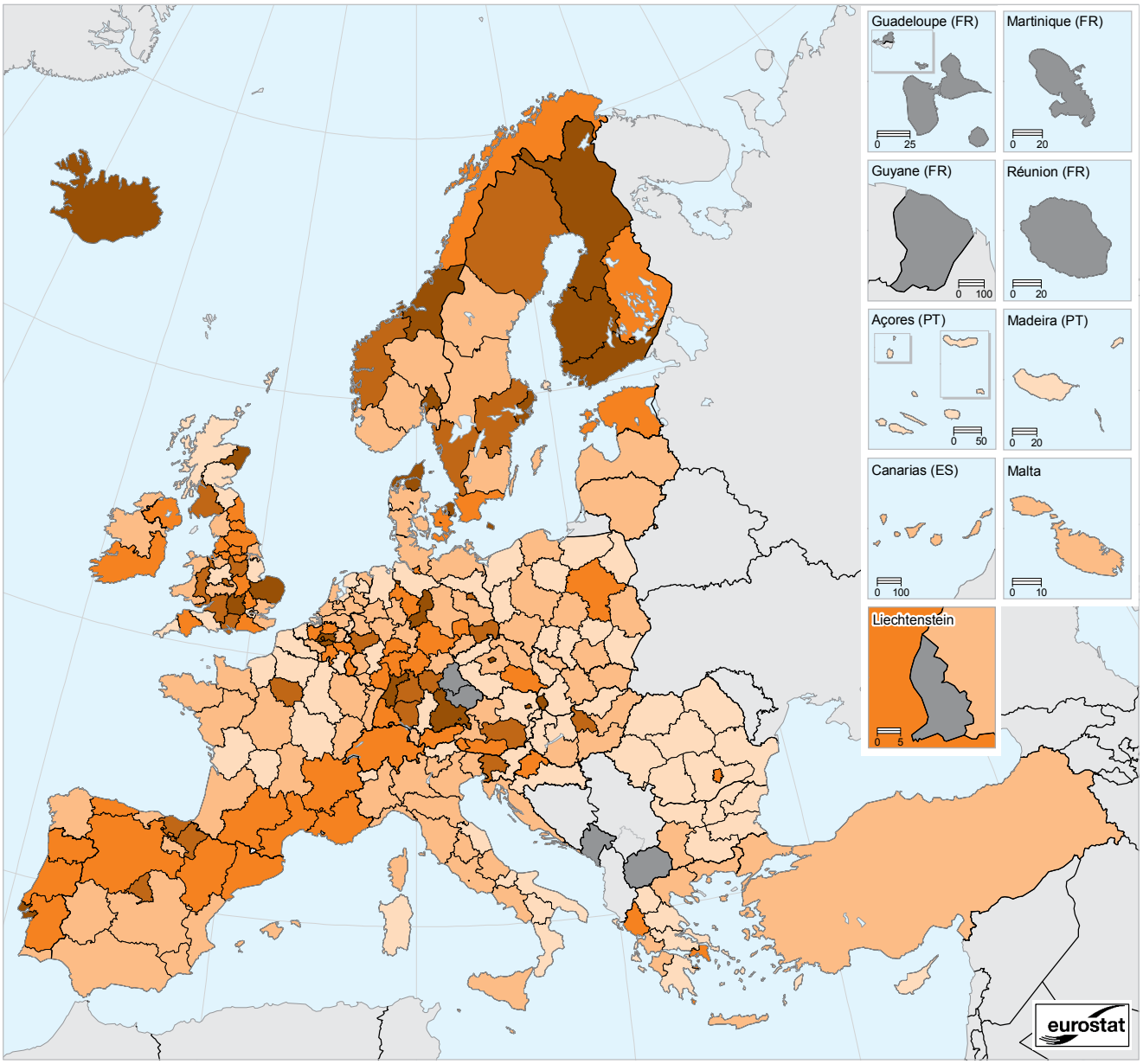
Cartography: Eurostat — GISCO, 04/2012

0 200 400 600 800 km

(1) Switzerland, 2008; Greece, 2005; Norway, Switzerland and Turkey, national level.
Source: Eurostat (online data codes: rd_e_gerdreg and nama_r_e2gdp)

Map 11.2: Proportion of researchers in the total number of persons employed, all sectors, by NUTS 2 regions, 2009 ([1])
(%)



([1]) Switzerland, 2008; Greece, 2005; France, 2001; EU-27, Ireland, the Netherlands and the United Kingdom, estimates; Switzerland and Turkey, national level.
Source: Eurostat (online data code: rd_p_persreg)

og Akershus were researchers. The share of researchers exceeded 1.5 %, but was 2.0 % or less, in a further 22 regions within the EU, six each of which were in the United Kingdom and Germany; several of the other 10 regions were in Sweden and Spain (three regions each), while the remainder were the capital city regions of France (note that the data for France relate to 2001), Hungary and Slovenia, as well as the Steiermark region of Austria. In 77 regions, the share of researchers was 0.5 % or less of all persons employed and these regions were distributed across 19 of the EU Member States.

Human resources in science and technology

Investment in research, development, education and skills are key policy areas for the EU, as they may be considered essential to economic growth and to the development of a knowledge-based and so-called 'smarter' economy. This has led to an increased interest in the role and measurement of skills of people with science and technology-related education or work. One way to measure the concentration of highly qualified people is to look at human resources in science and technology (HRST): the stock of HRST can be used as an indicator to determine how developed the knowledge-based economy is. HRST includes persons who have completed tertiary education (HRSTE) — for example, university degrees — and/or are employed in a science and technology occupation (HRSTO); the group of persons who meet both criteria are referred to as core HRST.

Map 11.3 focuses on the number of persons having completed a tertiary education that are employed in a science and technology (S & T) occupation; in other words, core HRST. The map shows the level of core HRST relative to the size of the labour force (the economically active population). In 2010, 15 of the 33 EU-27 regions with the highest shares of core HRST in the labour force (those exceeding 22 %) were capital city regions, while the remainder were generally other urban regions. Among all of the regions in the EU, the highest share was reported in Inner London (United Kingdom) where 33.4 % of the labour force was considered to be core HRST.

Beyond this concentration in capital cities, there were also relatively high shares of core HRST in the German regions which included the major cities of München and Hamburg, as well as in one region bordering Berlin and in Tübingen, while in Sweden the regions with a high share covered the major cities of Malmö and Göteborg. Other regions outside of capital city regions with over 22 % of their respective labour forces considered to be core HRST included the País Vasco (which includes Bilbao) in Spain, and Alsace and Midi-Pyrénées (including Strasbourg and Toulouse respectively) in France. Finally, there was a cluster of regions with high shares of core HRST that stretched from Luxembourg, through south-eastern Belgium up to Oost-Vlaanderen in the north of Belgium, with two more regions in the west and north of the Netherlands around the cities of Groningen and Utrecht.

Among the EFTA countries, the highest share (36.1 %) of the labour force classified as core HRST was recorded in the Norwegian capital city region of Oslo og Akershus, a higher share than in any region in the EU; five other Norwegian regions had shares over 22 %. Three Swiss regions recorded shares of core HRST above 22 % of the labour force, namely the Région lémanique (including the city of Genève), Nordwestschweiz (including Basel) and Zürich. Like Belgium, Switzerland was unusual in that several regions had particularly high shares of core HRST (over 22 %), but not the capital city region itself, as the Espace Mittelland (including Bern) recorded a share of 18.4 %.

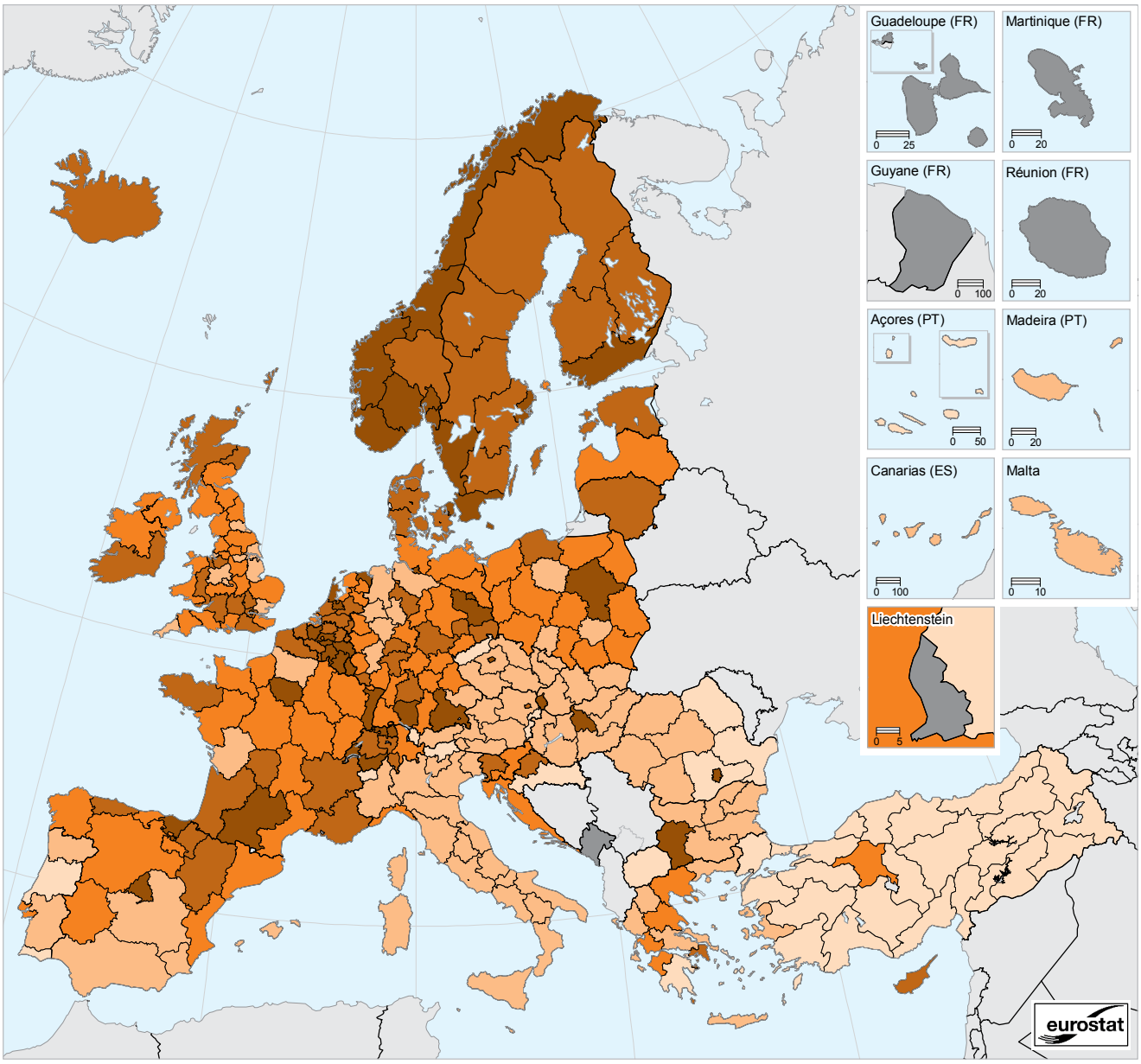
Employment in high-tech sectors

High-tech sectors include high-tech manufacturing and high-tech knowledge-intensive services, based on the activity classification NACE. The distinction between manufacturing and services is made due to the existence of two different methodologies. While R & D intensities are used to distinguish between high, medium-high, medium-low and low technology manufacturing industries, for services the proportion of the workforce that has followed a tertiary education is used to distinguish between knowledge-intensive services and less knowledge-intensive services. The service sector as a whole accounted for 69.0 % of employment in the EU-27 in 2010, but only 2.7 % of the total was employed in high-tech knowledge-intensive services. Around 15.9 % of the persons employed in the EU-27 worked in manufacturing, although the proportion that worked in high-tech manufacturing was around 1.1 %. When combined, these high-tech sectors accounted for 3.7 % of all employment in the EU-27.

Figure 11.1 shows the regional disparities in the high-tech sectors' share of total employment. This figure plots the highest and lowest shares of employment in high-tech sectors, as well as the national average and the share for the capital city region. Among those countries that have more than one NUTS level 2 region, it is clear that the share of high-tech sectors in employment varied quite substantially between regions. Urban regions, especially capital city regions or regions situated close to capitals, often exhibited the highest shares of employment in high-tech sectors. In fact, in all of the 25 multi-region countries shown in Figure 11.1 the employment share of high-tech sectors in the capital city region was above the national average and, in 20 of these, the capital city region had the highest share; the exceptions were Belgium, Germany, the Netherlands, the United Kingdom and Switzerland.

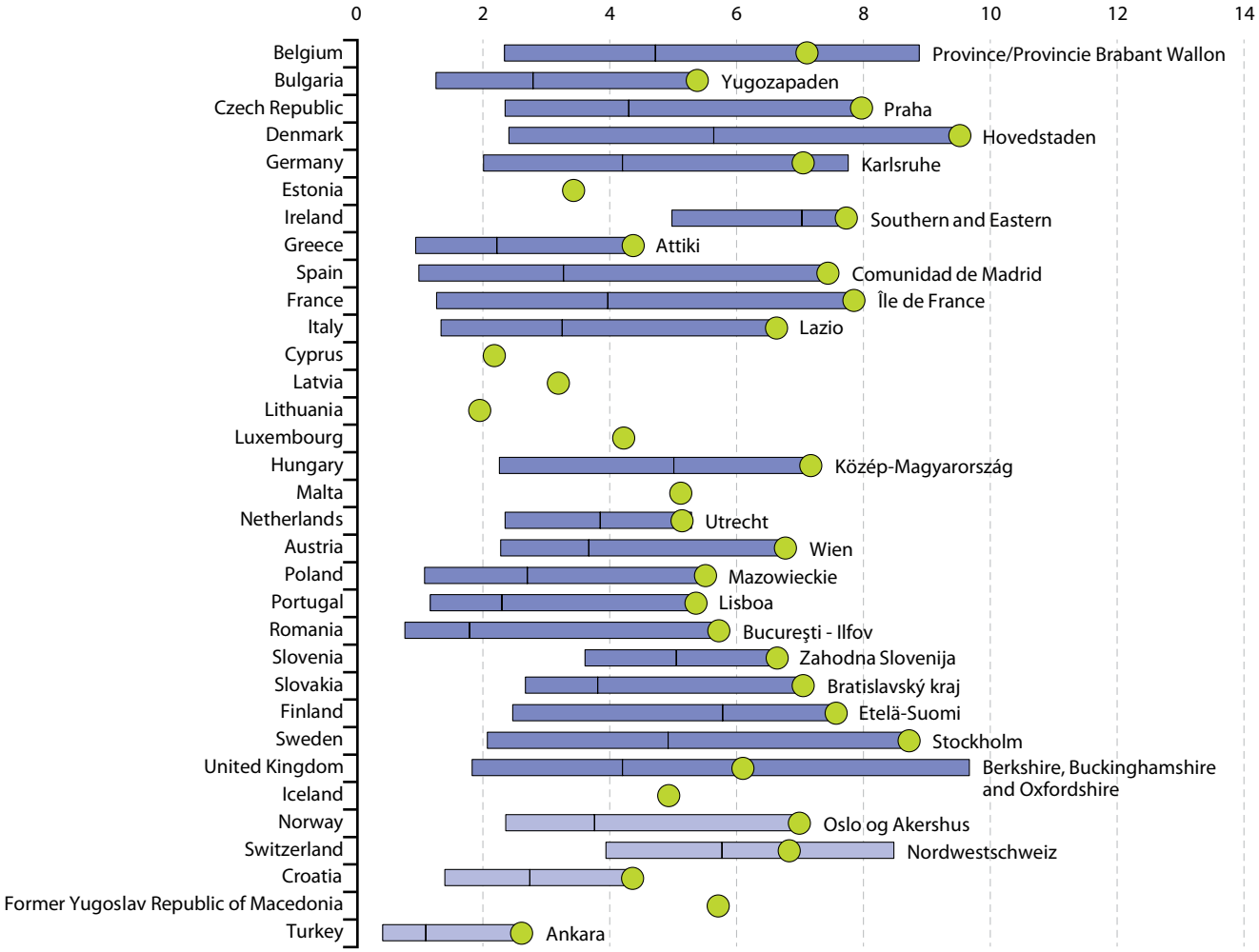
Considering all regions in the EU-27, the share of employment in high-tech sectors was highest in Berkshire, Buckinghamshire and Oxfordshire (United Kingdom), which

Map 11.3: Human resources in science and technology core (HRSTC), by NUTS 2 regions, 2010 ([1])
(% of active population)



([1]) Switzerland, 2009; Ciudad Autónoma de Melilla (ES63), Corse (FR83), Valle d'Aosta/Vallée d'Aoste (ITC2) and Åland (FI20), data lack reliability due to reduced sample size, but publishable.
Source: Eurostat (online data code: hrst_st_rcat)

Figure 11.1: Employment in high-tech sectors as a share of total employment, highest and lowest NUTS 2 region within each country, 2010 ([1])
(%)



([1]) High-tech sectors = high-technology manufacturing plus high-tech knowledge-intensive services (KIS); the graph shows the range of the highest to lowest region for each country; the black vertical line is the average (mean); the green circular marker is the capital city; the name of the region with the highest value is also included; the graph is based on available information (some regions are unreliable or not available); Switzerland, 2009; the former Yugoslav Republic of Macedonia, 2008.
Source: Eurostat (online data code: htec_emp_reg2)

is situated within close proximity of London, followed by Hovedstaden (Denmark), Province/Provincie Brabant Wallon (Belgium) and Stockholm (Sweden) — these were the only regions where more than 8 % of total employment was in high-tech sectors. Unlike the other indicators analysed in this chapter, this indicator did not show many clusters of regions within the same Member State near the top of the ranking: in fact, the 10 regions with the highest shares of employment in high-tech sectors were all from different Member States. The three lowest shares among the EU regions were registered in Romania (1.0 % or less of employment was in high-tech sectors), as was the case in one Spanish (Región de Murcia) and one Greek region (Dytiki Ellada).

Patents

Patent counts can provide a measure of invention and innovation and a time series of data is available with an analysis by region. However, care should be taken interpreting the data as not all inventions are patented and patent propensities vary across activities and enterprises; furthermore, patented inventions vary in technical and economic value.

Regional patent statistics for European Patent Office (EPO) patent applications build on information from addresses of inventors; this is not always the place (region) of invention as inventors do not necessarily live in the same region as the one in which they work; this discrepancy is likely to

be higher when smaller geographical units are used. Patent applications tend to be clustered geographically in a limited number of regions and this is especially true for high-tech activities. Map 11.4 shows that technological activity (based on patent applications) was very much concentrated in the centre of the EU. There were 91 NUTS level 3 regions in the EU (out of a total of 1 211 regions with data available) that had more than 250 patent applications per million inhabitants in 2008. Among these were 83 German regions, two regions in Austria, France and the Netherlands, and one each in Belgium and Italy. The highest number of patents relative to inhabitants was 1 251 in Erlangen, Kreisfreie Stadt, followed by 793 in the neighbouring region of Erlangen-Höchstadt; Erlangen is home to a number of research institutes, a university and various offices of the engineering group Siemens.

In the field of information and communication technology (ICT) patents (see Map 11.5) information is available for NUTS level 2 regions. Five regions within the EU had more than 100 ICT patent applications per million inhabitants in 2008, of which three were in southern Germany (Mittelfranken, Oberbayern and Freiburg) and two in Sweden (Sydsverige and Stockholm).

Figure 11.2 shows large differences between the top regions of each Member State in terms of the number of patents relative to the number of inhabitants in the field of high technology. Among the 21 EU Member States with more than one region at the NUTS level 2, the highest ratio of high-tech patents to the number of inhabitants was recorded in 12 of the capital city regions. As such, high-tech patent applications were less concentrated in capital city regions than employment in high-tech sectors (see Figure 11.1). Furthermore, in Belgium and the Netherlands, the capital city region recorded a ratio of high-tech patents to inhabitants that was lower than the national average. Considering all EU regions together, the region of Sydsverige in Sweden had the highest number of high-tech patent applications relative to population size, 85 per million inhabitants. Two German regions (Oberbayern and Mittelfranken) and the Swedish capital city region of Stockholm followed, each with around 75 high-tech patents per million inhabitants. Nord-Brabant in the Netherlands, Oberpfalz in Germany and the capital city region of Etelä-Suomi in Finland were the only other regions in the EU with 50 or more high-tech patent applicants per million inhabitants in 2008.

Data sources and availability

Eurostat collects statistics on research and development (R & D) under the legal requirements of Commission Regulation (EC) No 753/2004, which determines the dataset, breakdowns, frequency and transmission delays. The methodology for national R & D statistics is laid down in the *Frascati manual*: *proposed standard practice for surveys on research and experimental development* (OECD, 2002), which is also used by many non-member countries.

Statistics on human resources in science and technology (HRST) are compiled annually, based on microdata extracted from the EU labour force survey (EU LFS). The basic methodology for these statistics is laid down in the *Canberra manual* (OECD, 1995), which lists all the HRST concepts.

Data on high-technology manufacturing industries and knowledge-intensive services are compiled annually, based on data collected from a number of official sources (such as EU LFS and structural business statistics (SBS)). The high-technology manufacturing aggregates are defined in terms of R & D intensity, calculated as the ratio of R & D expenditure for an economic activity relative to its value added. For manufacturing, four groups have been identified, depending on the level of R & D intensity: high, medium-high, medium-low and low technology sectors. Services are classified into knowledge-intensive services (KIS) and less knowledge-intensive services. High-tech knowledge-intensive services include motion picture, video and television programme production, sound recording and music publishing activities, programming and broadcasting, telecommunications, computer programming and related activities, information service activities and research and development. High-tech manufacturing covers the manufacture of pharmaceutical products and pharmaceutical preparations and of computers and electronic and optical products.

Data on patent applications to the European Patent Office (EPO) are compiled on the basis of microdata from the EPO. The patent data reported include patent applications filed at the EPO during the reference year, classified by the inventor's region of residence and in accordance with the international patents classification of applications (IPC). Patent data are regionalised using procedures linking postcodes and/or place names to NUTS level 2 and 3 regions. Patent statistics published by Eurostat are almost exclusively based on the EPO worldwide statistical patent database, Patstat, developed by the EPO in 2005, using its patent data collection and its knowledge of patent data.

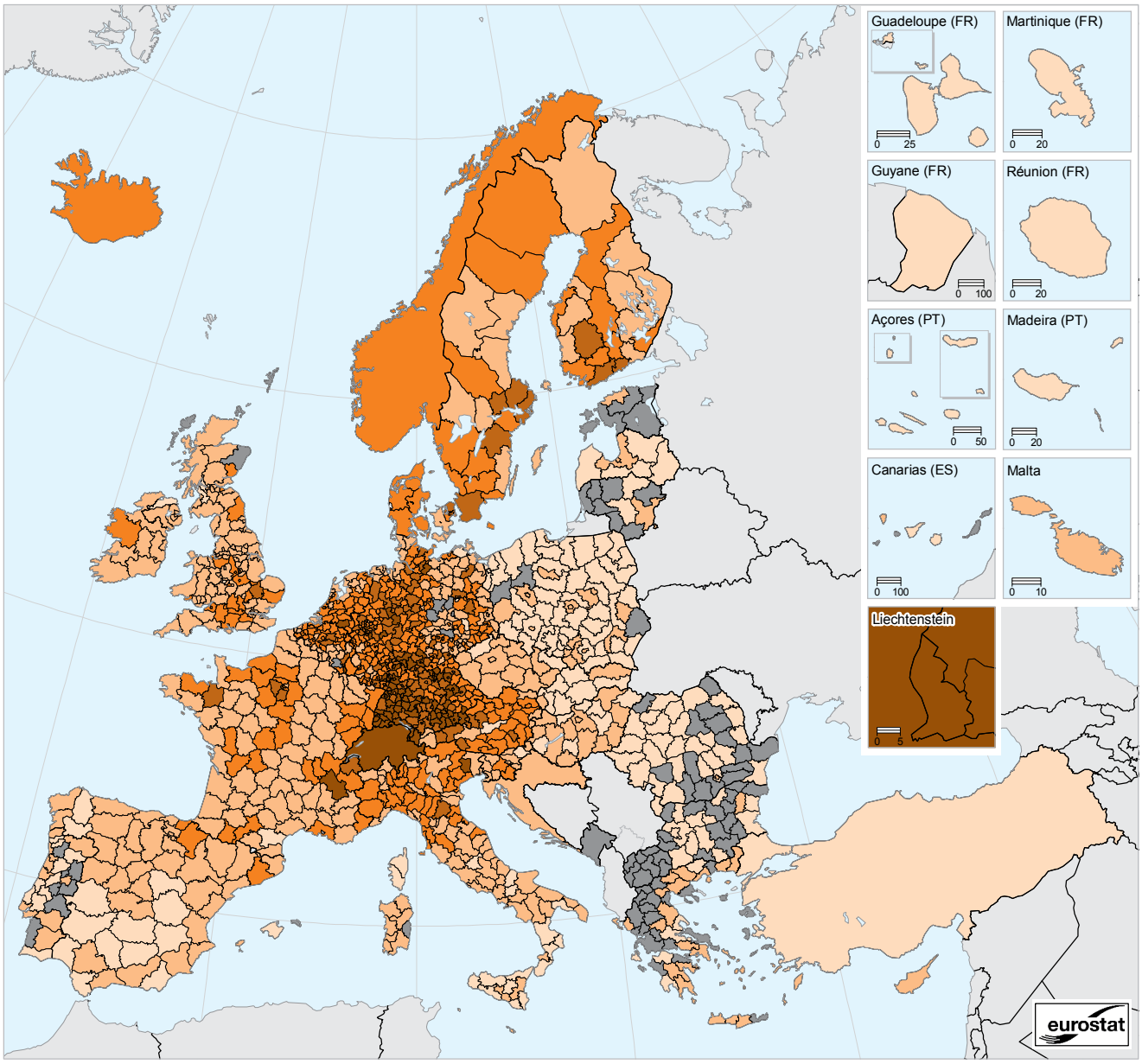
Further information

For further information about science, technology and innovation statistics please consult Eurostat's website at http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/introduction.

Context

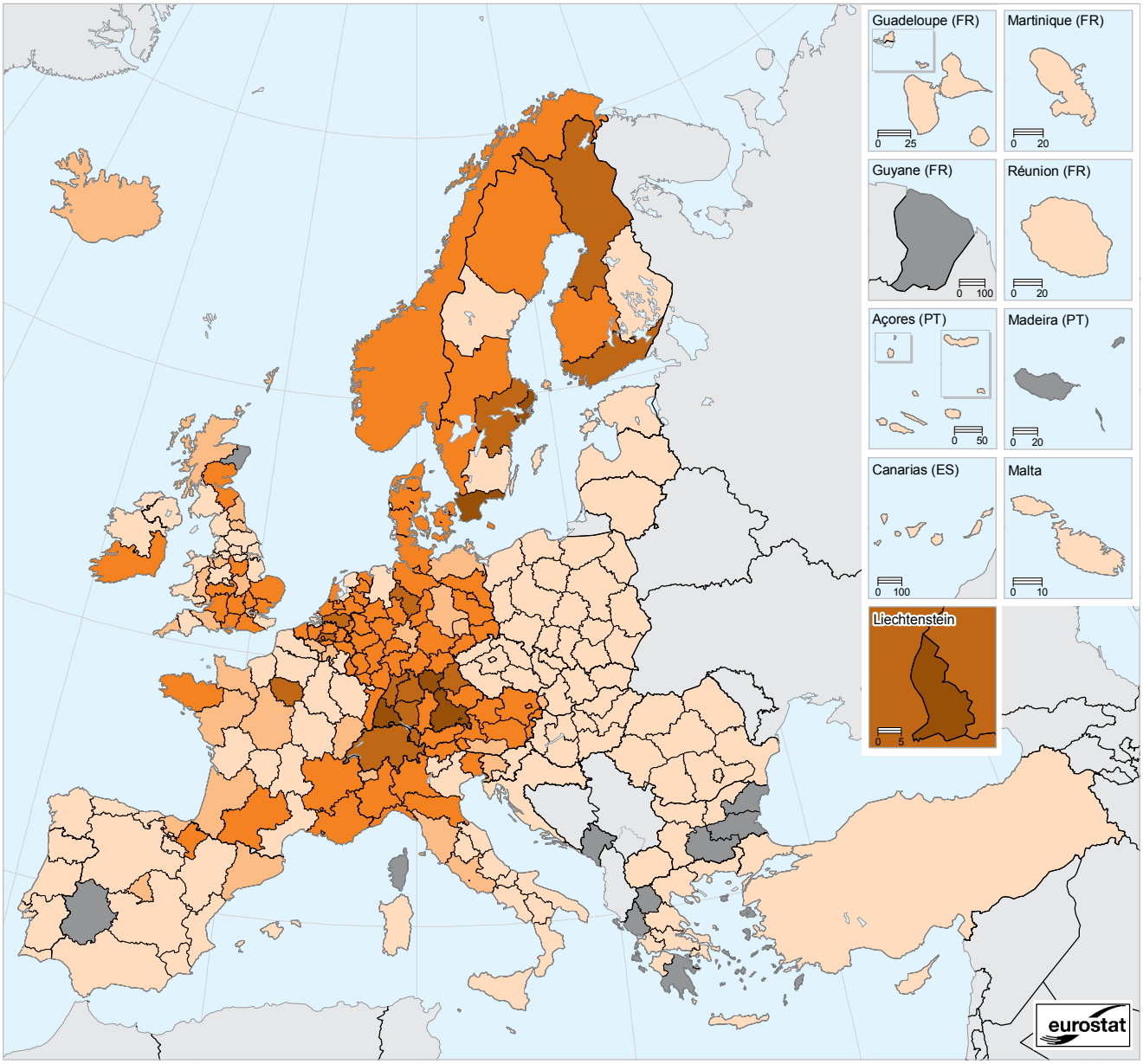
R & D is often considered as one of the driving forces behind growth and job creation. However, its influence extends well beyond the economic sphere, as it can potentially resolve

Map 11.4: Patent applications to the EPO, by NUTS 3 regions, 2008 (1)
(per million inhabitants)



(1) Provisional; for a limited number of regions the latest data are for 2007 or 2006; Iceland, Norway, Switzerland, Croatia and Turkey, national level.
Source: Eurostat (online data code: pat_ep_rtot)

Map 11.5: ICT patent applications to the EPO, by NUTS 2 regions, 2008 ([1])
(per million inhabitants)



(per million inhabitants)
EU-27 = 24.3

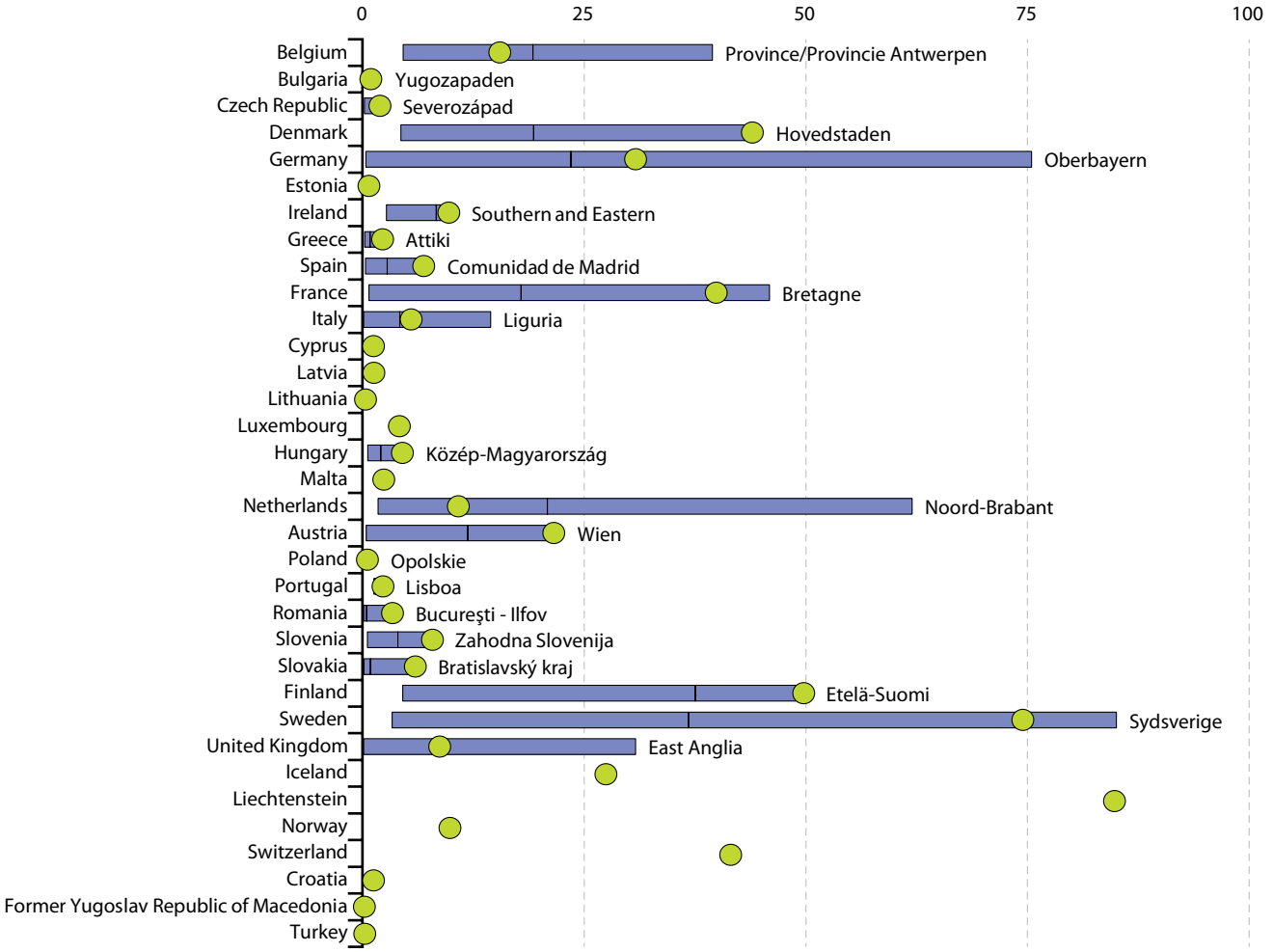
- <= 5
- 5 – 10
- 10 – 50
- 50 – 100
- > 100
- Data not available

Administrative boundaries: © EuroGeographics © UN-FAO © Turkstat
Cartography: Eurostat — GISCO, 04/2012

0 200 400 600 800 km

([1]) Provisional; for a limited number of regions the latest data are for 2007 or 2006; Norway, Switzerland, Croatia and Turkey, national level.
Source: Eurostat (online data code: pat_ep_rict)

Figure 11.2: High-technology patent applications to the EPO, highest and lowest NUTS 2 region within each country, 2008 (1)
(per million inhabitants)



(1) The graph shows the range of the highest to lowest region for each country; the black vertical line is the average (mean); the green circular marker is the capital city region; the name of the region with the highest value is also included; provisional; for a limited number of regions the latest data are for 2007 or 2006.
Source: Eurostat (online data code: pat_ep_rtec)

environmental or international security threats, ensure safer food or lead to the development of new medicines to fight illness and disease.

Since their launch in 1984, the EU's framework programmes for research have played a leading role in multidisciplinary research activities. The seventh framework programme for research and technological development (FP7) is the EU's main instrument for funding research in Europe; it runs from 2007 to 2013 and has a total budget of EUR 50 521 million, with an additional EUR 2 751 for 2007–11 for nuclear research and training activities to be carried out under the Euratom Treaty. FP7 aims to create European 'poles of excellence' across a wide array of scientific themes, such as information technologies, energy and climate change, health, food and social sciences.

The European research area (ERA) was launched at the Lisbon European Council in March 2000. The ERA aims to ensure open and transparent trade in scientific and technical skills, ideas and know-how. Europe's research efforts are often described as being fragmented along national and institutional lines. The ERA was given new impetus in April 2007 with the European Commission's Green Paper 'The European research area: new perspectives'. In May 2008, the ERA was re-launched as part of what has become known as the Ljubljana process, which included specific initiatives for five different areas: researchers' careers and mobility; research infrastructures; knowledge sharing; research programmes; and international science and technology cooperation. As a result, in the years through to 2020 the ERA will aim to establish a single European labour market for researchers, as well

as single markets for knowledge and for innovative goods and services.

In October 2010, the European Commission launched a Europe 2020 flagship initiative, titled the 'Innovation union' (COM(2010) 546 final); this sets out a strategic approach to a range of challenges like climate change, energy and food security, health and an ageing population. The proposals seek to use public sector intervention to stimulate the private sector and to remove bottlenecks which stop ideas reaching the market (such as access to finance, fragmented research systems and markets, under-use of public procurement for innovation and speeding-up harmonised standards and technical specifications). European innovation partnerships (EIPs) form part of the innovation union and are designed to act as a framework to address major societal challenges, bringing together activities and policies from basic research through to market-oriented solutions.

Horizon 2020 is planned as the framework programme for research and innovation after 2013, building upon FP7, the competitiveness and innovation framework programme (CIP) and the European Institute of Innovation and Technology (EIT). A Green Paper 'From challenges to opportunities: towards a common strategic framework for EU research and innovation funding' (COM(2011) 48) was adopted by the European Commission in February 2011 and proposed major changes to EU research and innovation funding to make participation easier, increase scientific and economic impact and provide better value for money.