# Research and innovation

7

# Introduction

One of the key aims of the Europe 2020 strategy is to foster research, development and innovation. This chapter presents statistical information analysing regional developments for a range of science and technology indicators within the European Union (EU), including the following domains: research and development (R & D), the number of researchers, human resources in science and technology (HRST), employment in high technology sectors and patent applications.

Europe has a long tradition of excellence in the fields of R & D and innovation. An innovative society may help businesses to maintain a competitive advantage, develop products with higher added value, stimulate economic activity and thereby safeguard or create jobs. In order to pool talent and achieve a necessary scale, policymakers seek to encourage transnational cooperation within the EU's research area.

Aside from ensuring a lasting economic development and job creation, investment in research and innovation has the purpose of helping tackle some of the most important global challenges, for example, in relation to health, energy or the environment. Indeed, the influence of new research and innovation extends well beyond the economic sphere, as it can lead to scientific or innovative solutions that impact on the daily lives of the population, for example, ensuring safer food, developing new medicines to fight illness and disease, or alleviating environmental pressures.

## Europe 2020

The Europe 2020 strategy is the EU's growth and jobs strategy launched in 2010. It aims to create the conditions for smart, sustainable and inclusive growth. The strategy includes five headline targets that are due to be achieved by the end of 2020; one of these covers research and development, namely, that expenditure on R & D should be equivalent to 3 % or more of the EU's GDP. The five headline targets are supported by seven flagship initiatives, identified as engines for growth and jobs, which are designed to provide a framework through which the EU and national authorities mutually reinforce their efforts.

The innovation union is supplemented by a Communication from the European Commission on 'Regional Policy contributing to smart growth in Europe 2020' (COM(2010) 553 final) which explores ways in which regional policy can be used to unlock the growth potential of the EU. The communication calls for the development of smart specialisation strategies across the EU's regions in order to identify those activities that offer the best chance of strengthening a region's competitiveness, while encouraging interaction between businesses, research centres and universities on the one hand and local, regional and national administrations on the other. Such strategies are designed to ensure a more effective use of public funds, helping regions to concentrate their resources on a few key priorities that exploit regional diversity, stimulate cooperation across national and regional borders and open up new opportunities.

### INNOVATION UNION — A FLAGSHIP EUROPE 2020 INITIATIVE

In 2010, the European Commission adopted a communication launching a flagship initiative titled 'Innovation union' (COM(2010) 546); this sets out a strategic approach to a range of challenges like climate change, energy and food security, health and an ageing population. It is hoped that the promotion of innovation in these areas will lead to innovative ideas being transformed into new economic activities and products, which in turn will generate jobs, green growth and social progress.

The innovation union seeks to use public sector intervention to stimulate the private sector, removing bottlenecks which may prevent ideas from reaching market, such as access to finance, a lack of venture capital, fragmented research systems, the under-use of public procurement for innovation, and speeding-up harmonised standards and technical specifications. The innovation union also seeks to promote coherence between European and national research policies, cutting red tape and removing obstacles to researchers' mobility, for example. Measures are being taken in the fields of patent protection, standardisation, public procurement and smart regulation to create a single European market for innovation.

To achieve these goals more than 30 separate actions have been identified, including a range of European innovation partnerships (EIPs), designed to act as a framework to address major societal challenges; for example, the EIP on active and healthy ageing aims to add an average of two years of healthy life for people in Europe.

***For more information:***

Innovation union — a Europe 2020 initiative: http://ec.europa.eu/research/innovation-union/index_en.cfm

### RESEARCH AND INNOVATION — COHESION POLICY FUNDING

Almost one quarter of the cohesion policy budget between 2007 and 2013, some EUR 86.4 billion, was allocated to innovation. This commitment was further strengthened for the 2014–20 programming period, with 30 % of cohesion policy allocations destined for innovation.

The Europe 2020 strategy is founded on the belief that sustainable growth is increasingly related to the capacity of regional economies to innovate and transform, adapting to an ever-changing and more competitive, global economy. As such, policymakers are increasingly of the opinion that the key drivers of research and innovation are most effectively addressed at a regional level.

Reducing the innovation divide between European regions is therefore a key task for cohesion policy. In this context, there are four thematic priorities for investment during the 2014–20 cohesion policy programming period: innovation and research; the digital agenda; support for small and medium sized businesses (SMEs); and the low-carbon economy. Investment will largely be made through the European Regional Development Fund (ERDF) which will be used to support the implementation of smart specialisation strategies.

***For more information:***

Cohesion policy and research and innovation: http://ec.europa.eu/regional_policy/activity/research/index_en.cfm

The European Commission assisted EU Member States to make use of remaining structural funds from the 2007–13 programme for research and innovation projects. To avoid an innovation divide between regions, smart specialisation strategies are employed so that the EU's structural funds and innovation and research programmes are used efficiently. Regional innovation strategies are increasingly characterised by accelerated implementation, optimising the impact of assistance, re-orienting activities towards areas which give regions the best chance of developing a competitive advantage, and maximising synergies between the different sources of Community funding for innovation, while continuing to focus on ensuring that every region across the EU may benefit from the potential of innovation.

### INNOVATION SCOREBOARDS — BENCHMARKING INNOVATION DEVELOPMENTS ACROSS THE EU

The innovation union flagship initiative is monitored through an innovation union scoreboard, which provides an assessment of the research and innovation performance of the EU Member States and the relative strengths and weaknesses of their research and innovation systems. The innovation union scoreboard identifies 25 key indicators for measuring the progress of the innovation union; it is released on an annual basis.

The innovation union scoreboard is accompanied, every two years, by a regional innovation scoreboard. Regional performance in innovation is thought to depend not only on the performance of local enterprises and research institutes, but also on interactions between regional and national policymakers, different stakeholders, enterprises, higher education institutes and research organisations.

The 2014 report identifies 27 separate regions across the EU as innovation leaders. These were located in just eight of the EU Member States: Denmark, Germany, Ireland, France, the Netherlands, Finland, Sweden and the United Kingdom. As such, innovation excellence was concentrated in relatively few regions across Europe.

***For more information:***

Innovation union scoreboard: http://ec.europa.eu/enterprise/policies/innovation/files/ius/ius-2014_en.pdf
Regional innovation scoreboard: http://ec.europa.eu/enterprise/policies/innovation/files/ris/ris-2014_en.pdf

## Framework programmes

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) was the EU's main instrument for funding research during the period from 2007 to 2013; it had a budget of EUR 50.5 billion, with an additional amount of up to EUR 5.25 billion for nuclear research and training activities to be carried out under the Euratom Treaty.

At the end of 2013, Regulation (EU) No 1291/2013 of the European Parliament and of the Council was adopted establishing Horizon 2020 — the Framework Programme for Research and Innovation (2014–2020). By coupling research and innovation, the goal of Horizon 2020 is to ensure Europe produces world-class science, removes barriers to innovation, bridges the gap between research and the market so technological breakthroughs are transformed into viable products, and makes it easier for the public and private sectors to work together. Horizon 2020 has a budget of almost EUR 80 billion, in addition to the private investment that it is expected this funding will attract; it is a financial instrument designed to implement the innovation union flagship initiative.

A Communication from the European Commission on 'Public-private partnerships in Horizon 2020' (COM(2013) 494 final) outlines a number of Joint-Technology Initiatives (JTI) that it believes can help deliver growth and societal benefits. In particular, it puts forward objectives regarding innovative medicines, fuel cells as energy converters, hydrogen as an energy carrier, clean sky proposals to reduce the environmental impact of the next generation of aircraft, bio-based industries, and electronic components and systems. It also sets out other areas for consultation: factories of the future; energy-efficient buildings; green vehicles; future internet; sustainable process industry; robotics; photonics; and, high performance computing.

## European research area

Europe's research efforts have often been described as being fragmented along national and institutional lines. The European research area (ERA) was launched at the Lisbon European Council in March 2000 and aims to ensure open and transparent trade in scientific and technical skills, ideas and know-how; it sets out to create a unified research area that is open to the world that promotes the free movement of researchers, knowledge and technology.

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. A European Commission communication titled 'A reinforced European research area partnership for excellence and growth' (COM(2012) 392 final) is designed to ensure the completion of the ERA by 2014, focusing on five key priority areas for reform:

- more effective national research systems;
- optimal transnational cooperation and competition;
- an open labour market for researchers;
- gender equality and gender mainstreaming in research, and;
- optimal circulation and transfer of scientific knowledge.

As part of the monitoring process, annual surveys and reports are released showing the progress made towards the completion of the ERA. Some of the key findings of the ERA 2013 progress report included that approximately three quarters of the EU Member States had defined a strategy for research, development and innovation and that 80 % of internationally mobile researchers believed mobility within the EU had increased the advancement of their research skills. While significant progress has been made in some areas, the report also highlighted a number of areas where further efforts may well be required in order to complete the ERA by 2014. For example, 40 % of researchers associated with European Higher Education Institutes considered that research job vacancies were not advertised well enough.

# Main statistical findings

Regional research, knowledge and innovative capacity depends on a range of factors — business culture, workforce skills, education and training institutions, innovation support services, technology transfer mechanisms, regional infrastructure, the mobility of researchers, sources of finance and creative potential. Education, training and lifelong learning are considered vital to developing a region's capacity to innovate, with universities across the EU increasingly implicated in the commercialisation of research, collaboration with regional businesses, and developing the entrepreneurial mind-set of students.

While EU funding seeks to target all regions, the innovation divide across Europe's regions reflects a pattern whereby the majority of EU regions are low absorbers of Framework Programme funding and structural funds designed to raise their modest levels of research and innovation. There appears to be a regional innovation paradox, whereby those regions characterised by established innovative activity maintain their position as innovative leaders, while those that trail behind fail to catch-up, despite efforts to specifically target funding and policy prescriptions to these regions.

## Research and development intensity

### *The average research and development spend in the EU-28 was EUR 526 per inhabitant in 2012*

Intramural R & D expenditure (GERD) was estimated to be EUR 266.9 billion across the EU-28 in 2012; this equated to an average of EUR 526 of research and development expenditure per inhabitant. A decade earlier, in 2002, R & D expenditure per inhabitant had stood at EUR 382 per inhabitant; note that these figures are in current prices and therefore include the effects of price inflation.

There was a steady increase in R & D expenditure per inhabitant during the last decade, aside from a minor contraction of 1.4 % in 2009 (compared with the year before); as such, the reduction in economic activity experienced during the financial and economic crisis was considerably greater than the corresponding decline in research and development expenditure per inhabitant.

### *R & D intensity was 2.06 % in 2012, compared with a Europe 2020 target of 3.00 %*

One of the five key Europe 2020 targets is for the ratio of R & D expenditure to GDP to be at least 3.00 % by 2020. This overall target is divided into a range of national targets, reflecting the position of each EU Member State and commitments agreed between the European Commission and national administrations through a series of reform programmes. These national targets for R & D expenditure vary considerably between EU Member States and ranged from less than 1.00 % of GDP in Greece, Cyprus and Malta up to 4.00 % of GDP for the traditionally R & D-intensive Member States of Finland and Sweden. Belgium, Denmark, Germany, Estonia, Spain, France and Slovenia have agreed to a 3.00 % target, the target for Italy has been set at 1.53 %, while no target has been established for the Czech Republic, Ireland and the United Kingdom.

R & D intensity is a derived indicator which measures the ratio of R & D expenditure to GDP. In the period between 2000 and 2007 there was little change in the EU-28's R & D intensity, as its level lay within a relatively restricted range from a low of 1.82 % to a high of 1.87 %. There followed successive increases, as R & D intensity rose from 1.84 % in 2007 to 1.91 % in 2008 and by a further 0.10 percentage points in 2009 (to reach 2.01 %); note that the increases in 2008 and 2009 reflect the contraction in economic activity during the financial and economic crisis rather than an expansion in the level of R & D expenditure. The EU-28's R & D intensity was almost unchanged in 2010 at 2.00 %, after which there were further increases in this ratio in 2011 (2.04 %) and again in 2012, when the EU-28's R & D intensity was estimated to be 2.06 %. In order to achieve the 3.00 % target that has been set for 2020, the EU-28's R & D intensity would need to grow, on average, by 0.12 percentage points each year.

SPOTLIGHT ON THE REGIONS: ZAHODNA SLOVENIJA (SI02), SLOVENIA

**Ljubljana, Slovenia**

The western Slovenian region of Zahodna Slovenija, which includes the cities of Ljubljana and Kranj, was the only NUTS 2 region from among the Member States that joined the EU in 2004 or later to record a research and development intensity of at least 3.00 %.

Research and development expenditure in Zahodna Slovenija was equivalent to 3.10 % of its GDP in 2011, which was almost twice as high as the corresponding share recorded in the other Slovenian region of Vzhodna Slovenija (1.68 %).

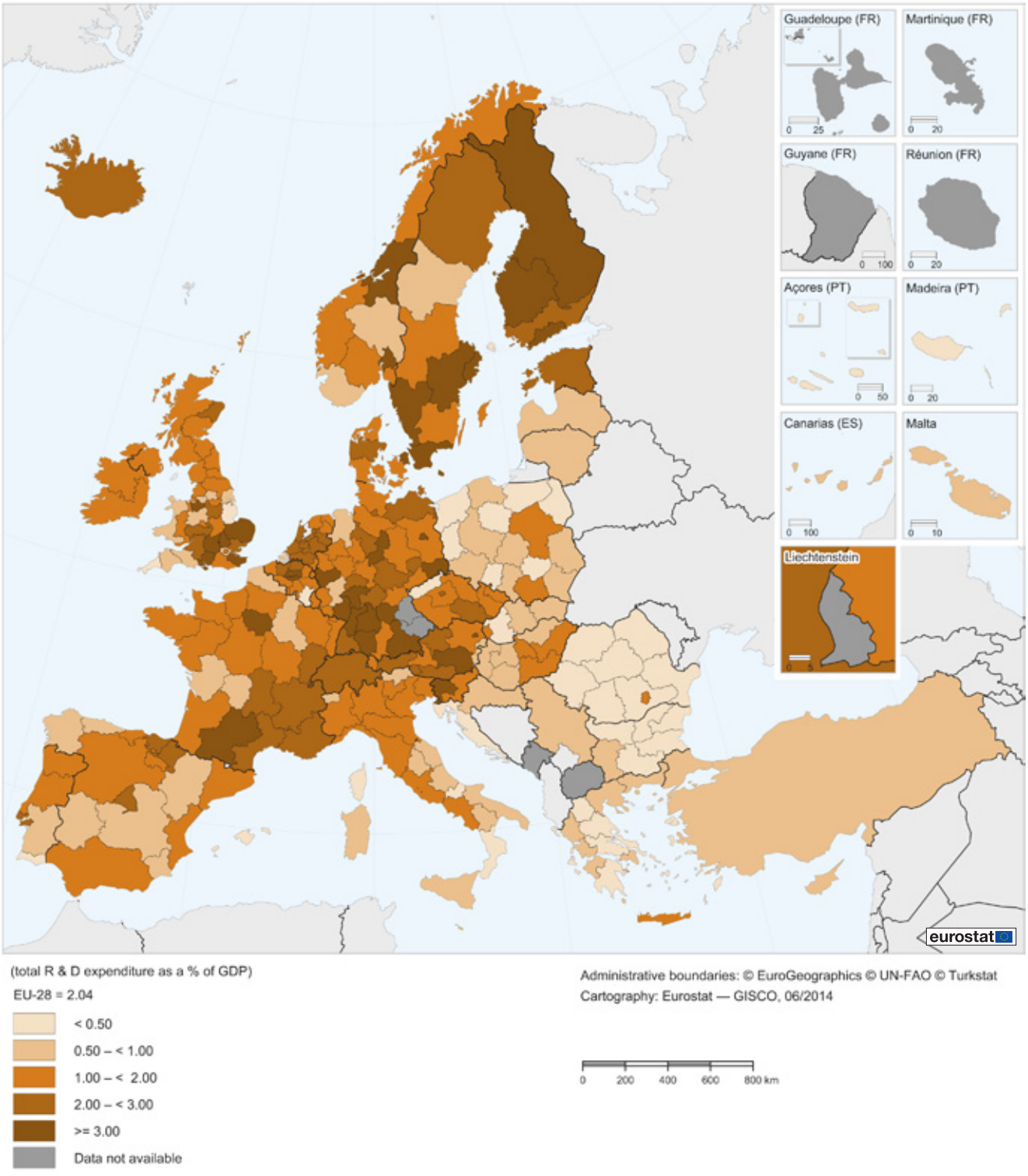
*Photo: Petar Milošević*

### *Research and development intensity concentrated in Germany, the United Kingdom and the Nordic Member States*

**Map 7.1** shows that 32 of the 266 NUTS 2 regions in EU-28 for which data are available had R & D intensities of 3.00 % or more in 2011; regional R & D expenditure is often available for 2012, however, regional economic accounts — used as the denominator in the ratio of R & D intensity — are only available through to 2011. Among these 32 regions, approximately one third (11 regions) were in Germany, six in the United Kingdom, four in Sweden, three in Finland, and two each in Belgium, France and Austria, while there was a single region from each of Denmark and Slovenia.

The nature of research and development is such that there are clusters of activity, in other words, specific geographical areas where R & D activity appears to be concentrated. These regions are often developed around academic institutions or specific high-technology industrial activities and knowledge-based services, which foster a favourable environment, thereby attracting new start-ups and highly qualified personnel such that the competitive advantage of these regions is further intensified. The concentration of research and development expenditure may be demonstrated

**Map 7.1:** R & D intensity, by NUTS 2 regions, 2011 (1)
(total R & D expenditure as a % of GDP)




(1) Luxembourg: 2010. Switzerland: 2008. Switzerland and Turkey: national level. EU-28, Ireland and the Netherlands: estimates.
*Source:* Eurostat (online data code: rd_e_gerdreg)

by the fact that the top 32 regions with R & D intensities of at least 3.00 % accounted for 44.1 % of the EU-28's total R & D expenditure in 2011.

**Figure 7.1** summarises the information on the concentration of R & D activities. National R & D intensities (shown by the size of the bubbles) were highest among the Nordic Member States and these countries also reported a relatively high share of their total number of regions had R & D intensities of 3.00 % or more.

### *Research-intensive clusters apparent in southern Germany*

The 11 German regions with R & D intensities of at least 3.00 % included clusters in both south-west and south-east Germany, as well as the specific, isolated regions of Braunschweig (the most R & D-intensive region in Germany, 7.77 %), Berlin and Dresden; together, these 11 German regions contributed 19.1 % of the total R & D expenditure in the EU-28.

In France, the highest R & D intensity in 2011 was recorded in the Midi-Pyrénées region (5.05 %); this area includes a cluster of R & D-intensive enterprises related to aerospace manufacturing, centred on Toulouse. The second highest level of R & D intensity was recorded in the capital region of Île de France (3.02 %). The overall level of R & D expenditure in these two regions was high, particularly in the Île de France, which recorded by far the highest level of R & D expenditure among any of the NUTS 2 regions across the EU (EUR 18.39 billion); it alone contributed 7.1 % of the EU-28's total R & D expenditure in 2011.

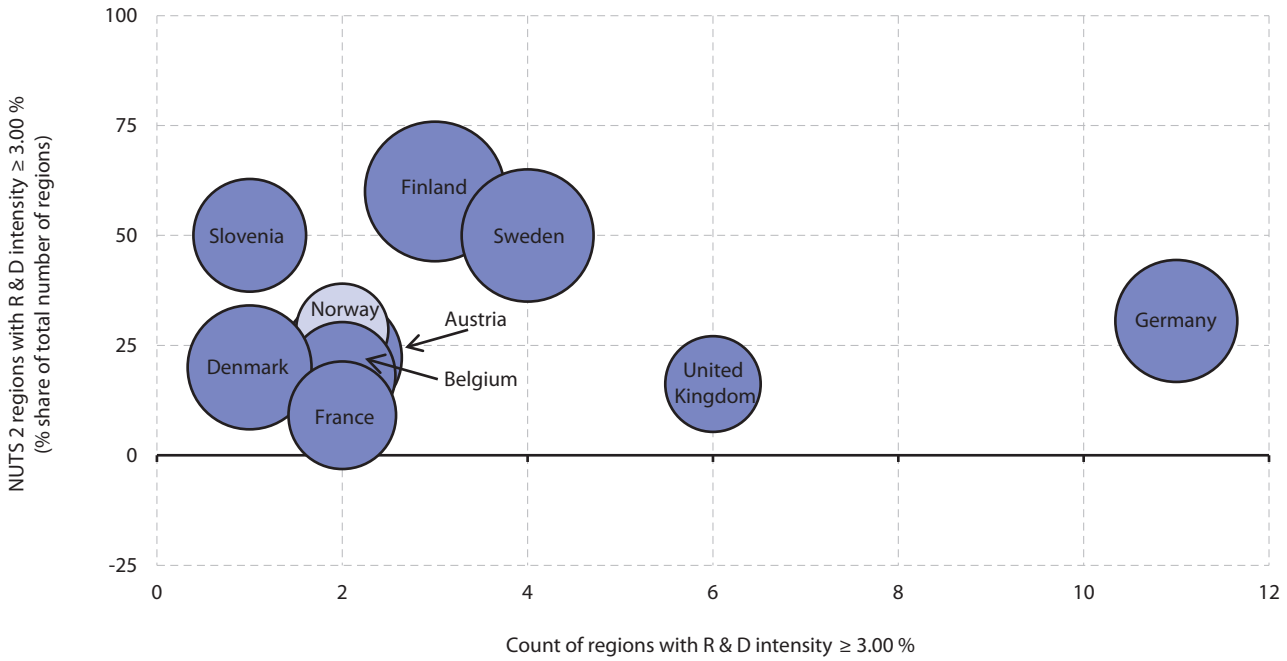
The most R & D-intensive regions of the United Kingdom in 2011 were Cheshire (6.28 %) and East Anglia (5.00 %); the former has much of its R & D spend accounted for by pharmaceuticals, while the latter includes the area around Cambridge, which has a science park that benefits from close ties with the nearby university.

Eight of the regions where R & D intensity was over 3.00 % were located in the Nordic Member States, where the highest R & D intensity was 5.08 % in the Danish capital region of Hovedstaden. These eight regions collectively contributed 8.7 % to R & D expenditure in the EU-28 in 2011.

The two Belgian regions with relatively high R & D intensity in 2011 were the Prov. du Brabant Wallon, which was the most R & D-intensive region in the EU (8.92 % of GDP), and the neighbouring Prov. Vlaams-Brabant (3.76 %). As well as a large industrial area around the Belgian capital, these regions include the university towns of Louvain-la-Neuve (which has various science parks) and Leuven, and is a global centre for research into vaccines.

**Figure 7.2** summarises the spread of R & D intensities across the regions of each EU Member State, ranked on national averages. Finland and Sweden were the only EU Member States to record R & D intensities of more than 3.00 % in 2011, although Denmark was only marginally below this rate, at 2.98 %. Capital regions recorded the highest level of R & D intensity in 11 of the 22 multi-regional EU Member States for which data are available. When this was not the case, the capital region generally recorded an R & D intensity that was above the national average; the only exceptions to this rule were Belgium and the United Kingdom, where regions

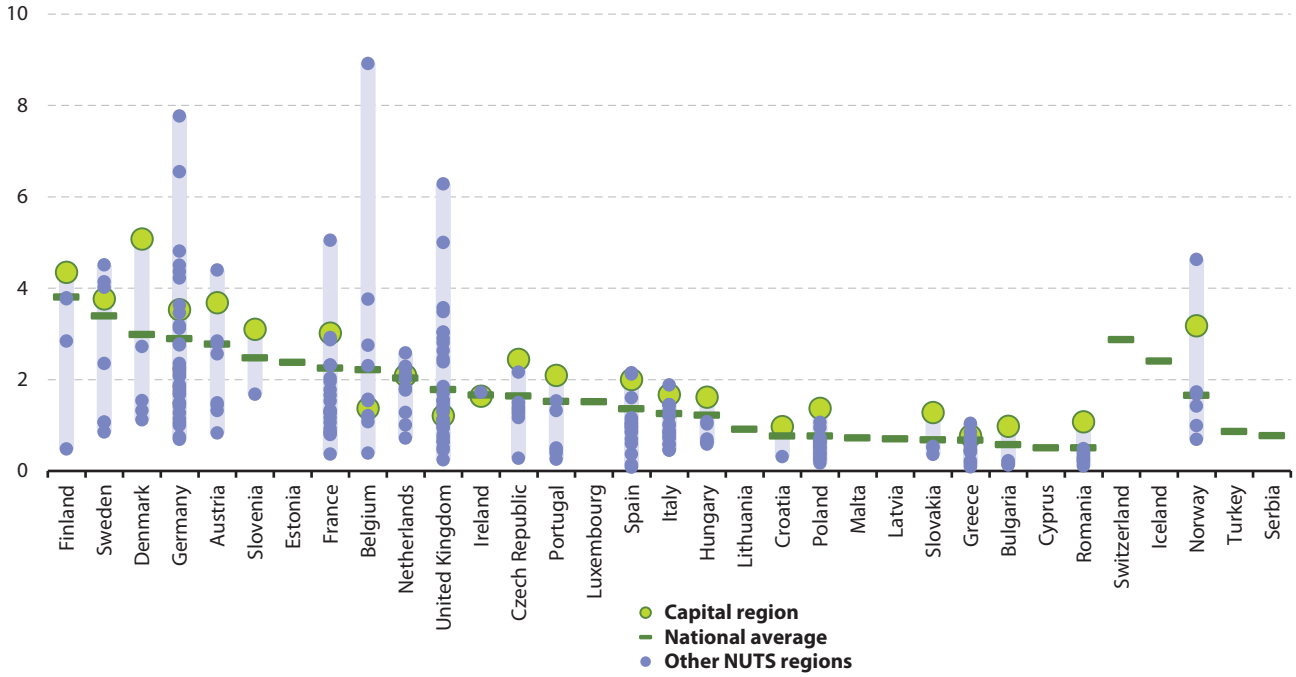
**Figure 7.1:** Regions with R & D intensity greater than or equal to 3.00 %, by NUTS 2 regions, 2011 (1)




(1) The size of the bubble reflects national R & D intenstity. Countries that are not shown do not have any regions with R & D intensity greater than 3.00 %. Luxembourg: 2010. Guadeloupe (FR91), Martinique (FR92), Guyane (FR93), Réunion (FR94), Liechtenstein, Switzerland, Montenegro, the former Yugoslav Republic of Macedonia and Turkey: not available. Ireland and the Netherlands: estimates. Niederbayern (DE22) and Oberpfalz (DE23): confidential.

*Source:* Eurostat (online data code: rd_e_gerdreg)

**Figure 7.2:** Regional disparities in R & D intensity, by NUTS 2 regions, 2011 (1)
(total R & D expenditure as a % of GDP)




(1) The light purple shaded bar shows the range of the highest to lowest region for each country. The dark green bar shows the national average. The green circle shows the capital city region. The dark purple circles show the other regions. Luxembourg: 2010. Switzerland: 2008. Ireland and the Netherlands: estimates.
*Source:* Eurostat (online data code: rd_e_gerdreg)

surrounding the capital region recorded some of the highest R & D intensities, and Ireland. Those multi-regional EU Member States with relatively low national R & D intensities tended to display a narrow range of intensities across their regions; this was particularly true for Bulgaria, Ireland, Greece, Croatia, Hungary, Romania and Slovakia.

## Researchers

### *There were 2.55 million researchers active across the EU in 2011*

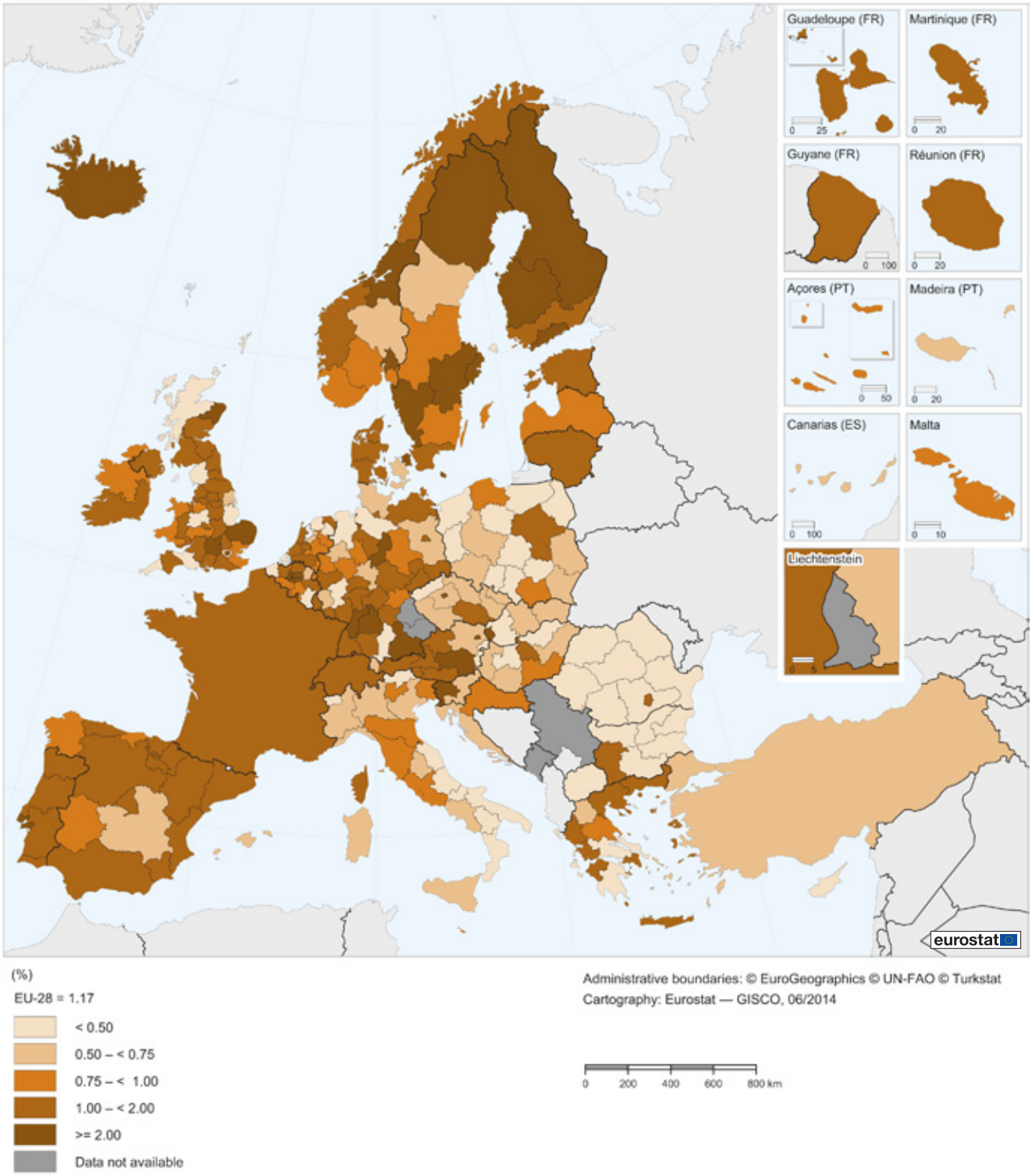
Researchers are directly employed within R & D activities and are defined as 'professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and in the management of the projects concerned'. There were an estimated 2.55 million researchers active across the EU-28 in 2011. Their number has grown at a steady pace in recent years, rising from 1.80 million in 2003, with an average rate of growth equal to 4.45 % per annum between 2003 and 2011. An alternative unit of measure for labour input adjusts the number of researchers to take account of different working hours and working patterns. Based on this measure, there were 1.63 million full-time equivalent researchers in the EU-28 in 2011.

**Map 7.2** provides an overview of the regional distribution of the share of researchers in total employment (measured as a headcount). The EU-28 average was estimated to be 1.17 % in 2011, an increase of 0.1 percentage points when compared with 2009. The regional information for this indicator is generally provided for 2011, although there are a number of exceptions to this rule (see the footnote to the map).

### *Distribution of researchers was also clustered — particularly in capital regions*

The distribution of researchers was relatively concentrated in a few clusters of regions where research and development intensity was high. As a result, there was a skewed distribution as only 88 of the 245 regions for which data are available (note that data for France are only available at the national level) reported a share of researchers in total employment that was above the EU-28 mean of 1.17 %, while the median share across all NUTS 2 regions was 0.91 %. The main difference between the patterns displayed in **Map 7.1** and **Map 7.2** was that the distribution of researchers tended to be somewhat lower in those regions characterised as having a high degree of research intensity in the business sector, while the relative importance of researchers was more concentrated in those regions characterised as having higher education establishments and research institutes; this was often the case in capital regions. This pattern of concentrated clusters was repeated across most of the EU Member States, with a small number of regions recording a relatively high share of researchers in total employment — often, far above national averages.

**Map 7.2:** Share of researchers in total persons employed, by NUTS 2 regions, 2011 (1)
(%)




(1) Molise (ITF2) and Basilicata (ITF5): 2010. Luxembourg, Zachodniopomorskie (PL42), Lubuskie (PL43), Kujawsko-Pomorskie (PL61), Warmińsko-Mazurskie (PL62) and the former Yugoslav Republic of Macedonia: 2009. Switzerland: 2008. France, Switzerland and Turkey: national level. EU-28, Ireland and the United Kingdom: estimates.
*Source:* Eurostat (online data code: rd_p_persreg)

There were 26 NUTS 2 regions in the EU where the share of researchers in total employment was 2.0 % or more in 2011 (as shown by the darkest shade in **Map 7.2**). The highest share was recorded in Inner London (4.06 %), while there were two regions that shared second place in the ranking, namely, the Danish and Slovakian capital regions of Hovedstaden and Bratislavský kraj (3.81 %). The capital regions of Lisboa, Wien, Helsinki-Uusimaa, Praha and the Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest were also present among the 10 regions with the highest proportion of researchers in total employment. As such, the only non-capital regions in the top 10 were the highly research-intensive region of the Prov. Brabant Wallon and the East Anglia region of the United Kingdom.

At the other end of the range, researchers accounted for less than 0.5 % of total employment in 56 NUTS 2 regions across the EU (as shown by the lightest shade in **Map 7.2**). These regions were often on the geographic periphery in relatively sparsely-populated areas, for example, the Åland islands (which displayed a totally different pattern to the other regions of Finland) or two regions at the extremities of the United Kingdom — the Highlands and Islands (of Scotland) and Cornwall and Isles of Scilly (in south-west England); otherwise, the majority of the regions with relatively low shares of researchers were located in southern Italy and in eastern Europe.

## Human resources in science and technology

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). Those persons who are classified as one or other type form the aggregate stock of total HRST, while the subgroup of persons who meet both of these criteria are referred to as core HRST (HRSTC).

### *Human resources in science and technology: almost one third of the EU-28's population*

There were 115.1 million persons in the EU-28 considered as HRST in 2012, of which 45.8 million were categorised as core HRST. As such, some 30.3 % of the EU-28's population (aged 15–74) was categorised as HRST in 2012.

### *Majority of the population in Inner London, Helsinki-Uusimaa and Stockholm classified as HRST*

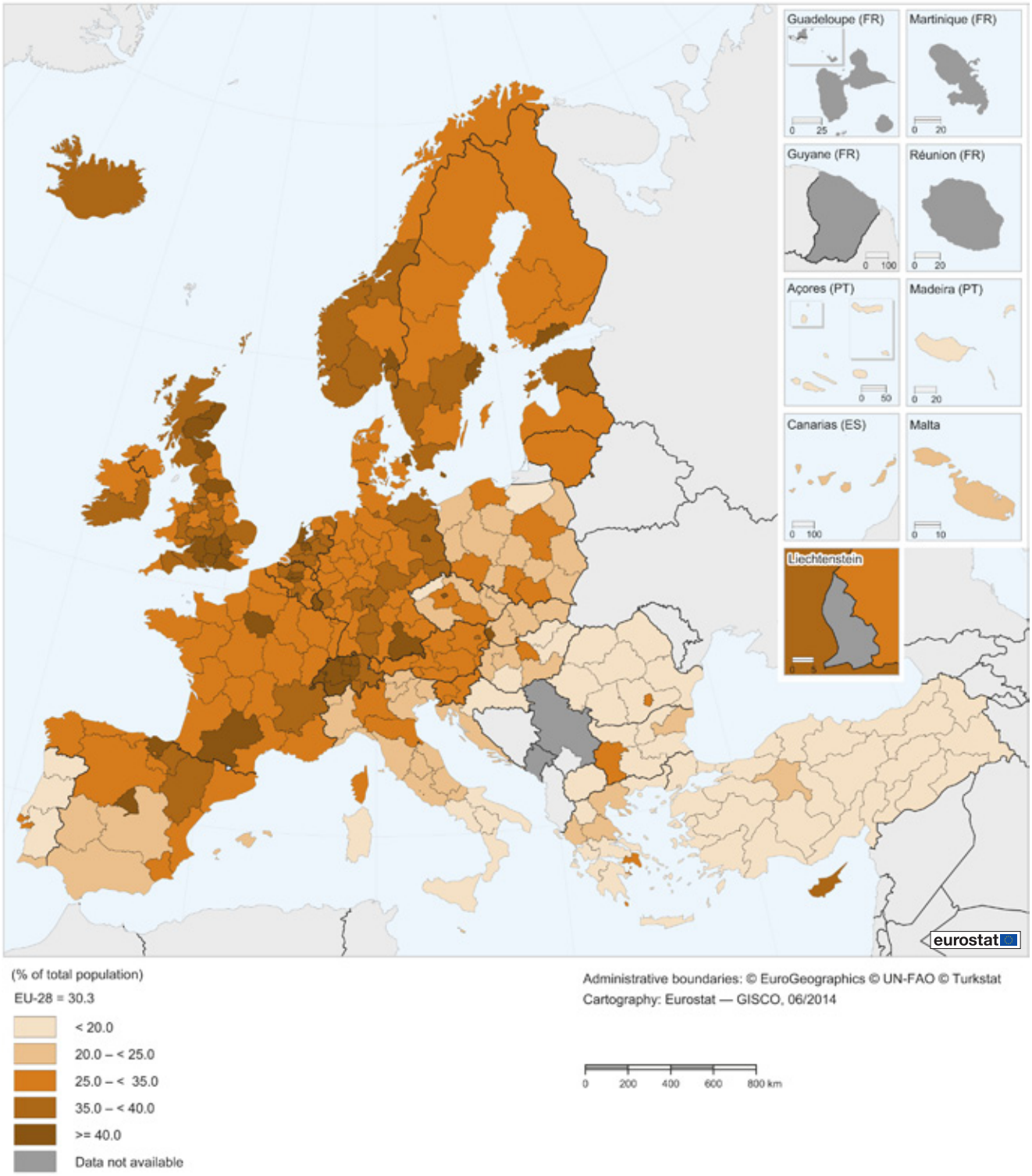
There were 26 NUTS 2 regions across the EU-28 where at least 40 % of the total population were classified as HRST in 2012 (as shown by the darkest shade in **Map 7.3**). Of these 26 regions there were just three where the majority of the population was categorised as HRST: each of these was a capital region from one of the most research-intensive EU Member States, namely Inner London (59.4 %), which recorded, by some distance, the highest share, and the Nordic capital regions of Helsinki-Uusimaa (50.9 %) and Stockholm (50.0 %).

Beyond a concentration in most capital regions, there were also relatively high shares of HRST in the total population in a number of regions close to capital cities — for example: the Prov. Brabant Wallon and the Prov. Vlaams-Brabant around the Belgian capital; Utrecht in the Netherlands; and Outer London, Berkshire, Buckinghamshire and Oxfordshire, Bedfordshire and Hertfordshire, and Surrey, East and West Sussex in the United Kingdom. Some of the remaining regions that displayed relatively high shares of HRST were characterised as being largely urbanised, industrial areas — for example, Oberbayern in Germany or the País Vasco in Spain, while others were characterised by their specialisation in a particular industrial activity — for example, the aerospace sector in the Midi-Pyrénées region of France or activities linked to oil and natural gas exploration off the coast of North Eastern and Eastern Scotland.

There were several clusters of regions with relatively high shares of HRST in the total population. These included one running from southern Germany into Switzerland, one that stretched across much of the Benelux countries, and one that ran from south-west France into north-east Spain. More generally, a majority of the regions in the Nordic Member States reported a high proportion of HRST — this was particularly true in Norway, southern Sweden, southern Finland and the Danish capital region.

There were 37 NUTS 2 regions where the share of HRST in the population was less than 20 % in 2012 (as shown by the lightest shade in **Map 7.3**). These were widely distributed across southern and eastern Europe, from Portugal, through southern Spain into most of Italy and much of south-eastern Europe (aside from capital regions).

**Map 7.3:** Human resources in science and technology (HRST), by NUTS 2 regions, 2012 (1)
(% of total population)




(1) Corse (FR83): low reliability.
*Source:* Eurostat (online data code: hrst_st_rcat)

### *Core HRST accounted for almost four tenths of the active population in Inner London*

**Figure 7.3** shows the distribution of core HRST as a share of the economically active population in 2012, ranked by national averages; note that this indicator uses a different denominator to that employed for **Map 7.3**. The skewed nature of the distribution is clearly apparent with a higher number of regions below their respective national average, while capital regions tended to record much higher shares. This pattern was particularly apparent in the United Kingdom, where core HRST accounted for 39.7 % of the economically active population in Inner London — the highest figure across any of the NUTS 2 regions for which data are available, followed by Luxembourg (a single region) where a share of 35.6 % was recorded.

Among the multi-regional EU Member States, the capital region generally recorded the highest share of core HRST in the economically active population. Indeed, the highest shares of core HRST in Finland, Denmark, Sweden, Ireland, Slovenia, Hungary, Bulgaria, the Czech Republic, Portugal, Austria and Slovakia were recorded in their respective capital regions, while none of the remaining regions in any of these Member States recorded a share of core HRST that was above the national average. Those capital regions which did not follow this pattern generally maintained a share of core HRST that was above their respective national averages. The only exception was Croatia (where the difference between the national average and that for the capital region was just 0.4 percentage points). Among the non-member countries, Switzerland was also an exception to this general rule.

## Employment in high-tech sectors

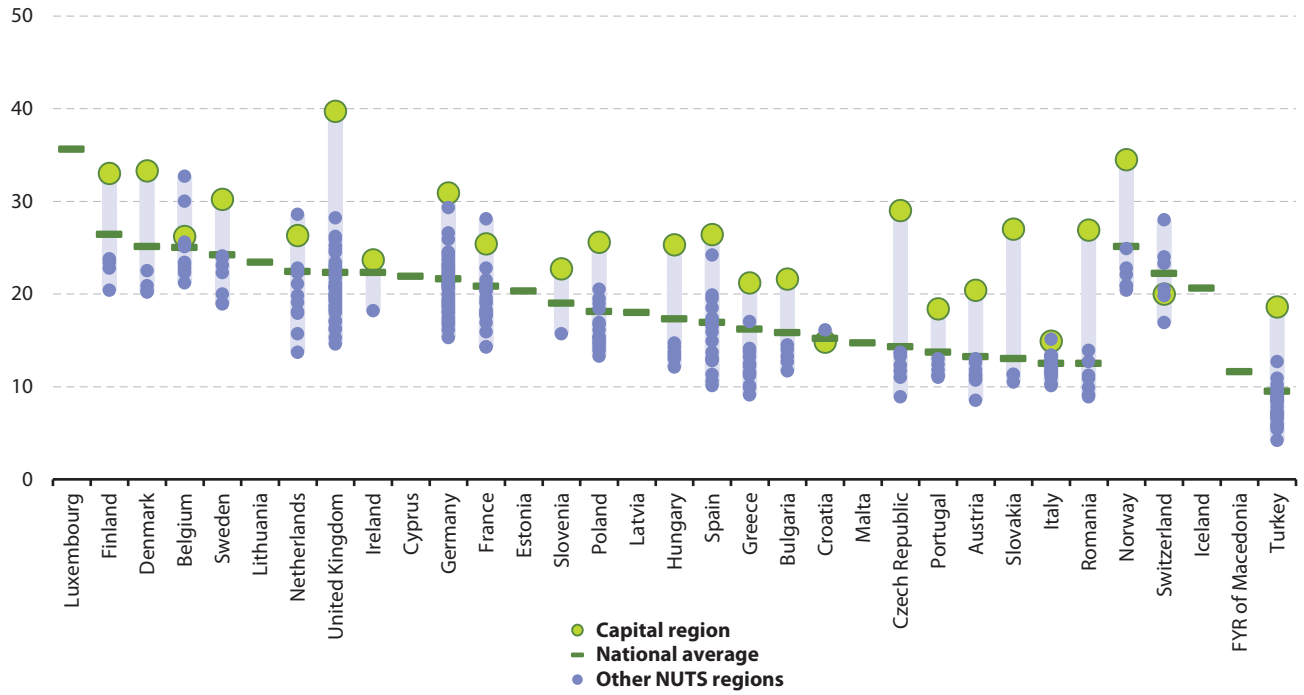
High-tech sectors include high-tech manufacturing and high-tech knowledge-intensive services, which are defined on the basis of the activity classification, NACE. The distinction between manufacturing and services is made due to the existence of two different methodologies. While R & D intensities are 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.

### *Some 8.5 million persons in the EU-28 worked in high-tech sectors in 2012*

There were an estimated 8.5 million persons employed across the EU-28 within high-tech sectors in 2012 (the estimate includes data for the United Kingdom for 2011), equating to 3.9 % of total employment. **Map 7.4** presents information for regional employment shares of those working in high-tech sectors.

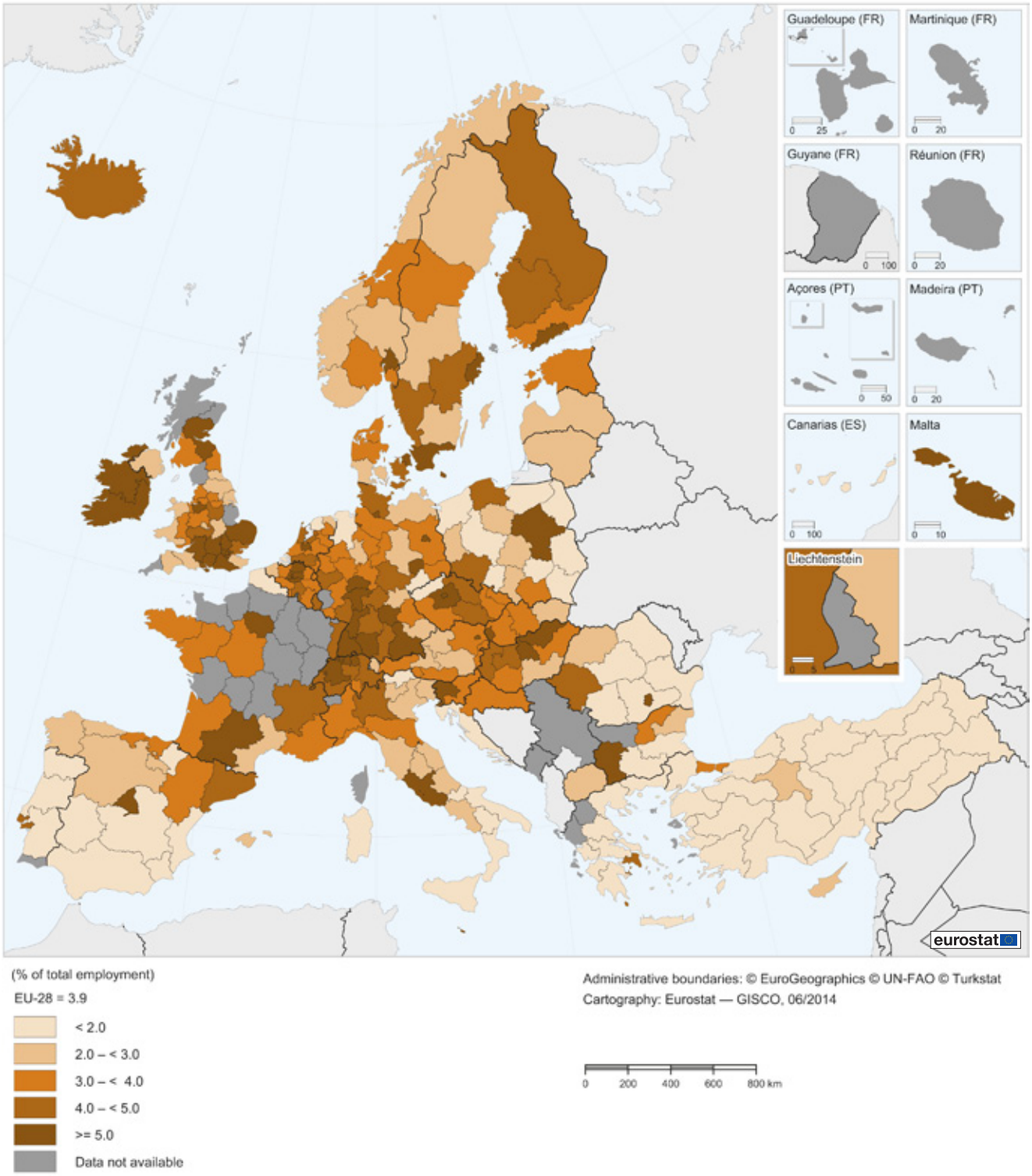
Urban regions, especially capital regions or regions situated close to capitals, often exhibited the highest shares of employment in high-tech sectors; this was particularly true in the Nordic Member States, Ireland and Slovakia. In those EU Member States where the capital region did not record the highest share of employment in high-tech sectors, it did nevertheless record a share above the national average, except in the Netherlands. Generally, the distribution of

**Figure 7.3:** Human resources in science and technology core (HRSTC), by NUTS 2 regions, 2012 (1)
(% of the economically active population)




(1) The light purple shaded bar shows the range of the highest to lowest region for each country. The dark green bar shows the national average. The green circle shows the capital city region. The dark purple circles show the other regions. Corse (FR83) and the French overseas regions (FR9): not available.
*Source:* Eurostat (online data code: hrst_st_rcat)

**Map 7.4:** Employment in high-tech sectors, by NUTS 2 regions, 2012 (1)
(% of total employment)




(1) Severen tsentralen (BG32), Yugoiztochen (BG34), Anatoliki Makedonia, Thraki (EL11), Notio Aigaio (EL42), Alentejo (PT18) and Tees Valley and Durham (UKC1): 2011. Peloponnisos (EL25) and Molise (ITF2): 2010. Data for several regions have low reliability (too numerous to document).
*Source:* Eurostat (online data code: htec_emp_reg2)

SPOTLIGHT ON THE REGIONS:
PROV. BRABANT WALLON (BE31), BELGIUM

**Louvain-la-Neuve, Prov. Brabant Wallon**

Some 9.2 % of employment in the Prov. Brabant Wallon (located to the south of the Belgian capital) was in high-tech sectors in 2012; this was more than twice as high as the EU-28 average.

There were also relatively high shares of employment in high-tech sectors in the neighbouring Belgian regions of the Prov. Vlaams-Brabant and the capital Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest.

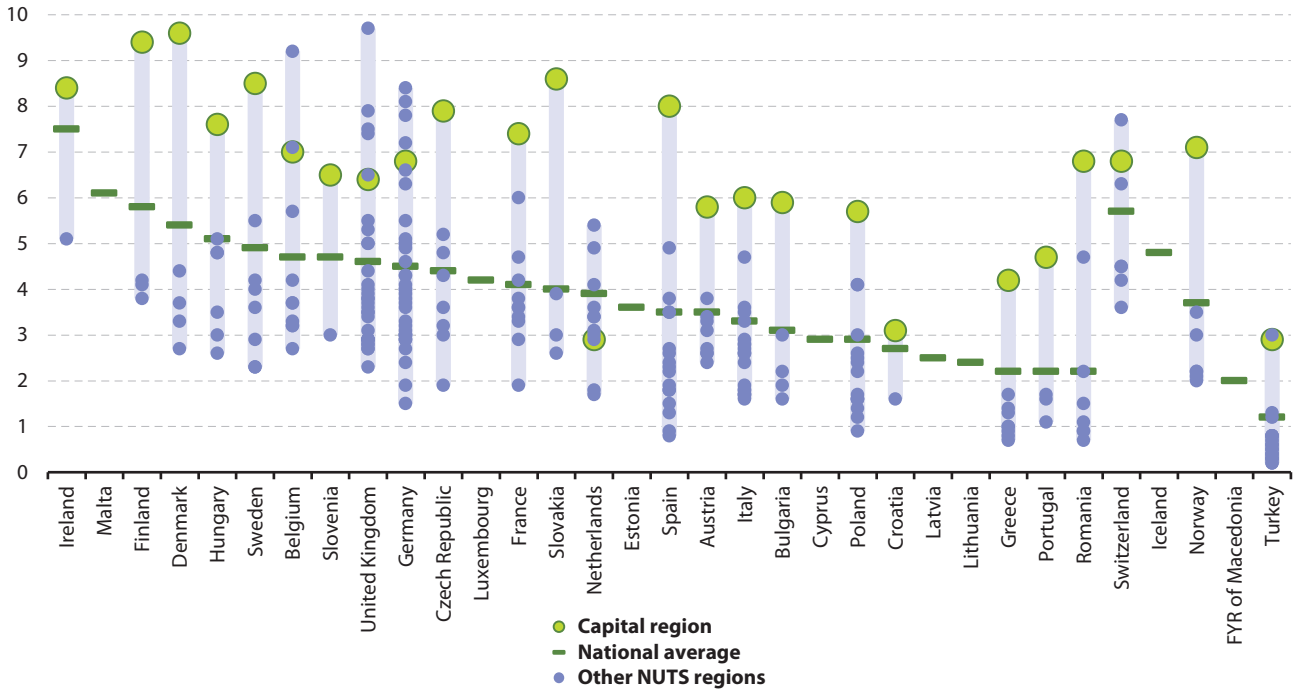
*Photo: Jonathan Nélis*

employment shares was often skewed, with the vast majority of regions reporting shares below the national average. The pattern in Germany and the United Kingdom was somewhat different, as both of these EU Member States recorded a relatively high number of regions with employment shares in high-tech sectors that were above 5 % (see **Figure 7.4**).

### *Employment in high-tech sectors reached almost 10 % in Berkshire, Buckinghamshire and Oxfordshire, Hovedstaden, Helsinki-Uusimaa and the Prov. Brabant Wallon*

**Map 7.4** shows the regional disparities in the share of high-tech sectors in total employment in 2012. There were 47 regions where this share was at least 5.0 % (as shown by the darkest shade). Among these, 10 regions recorded shares of at least 8.0 %. The highest regional share was registered in the United Kingdom in Berkshire, Buckinghamshire and Oxfordshire (9.7 %), where there is a high propensity for enterprises engaged in information and communications technology and life sciences to locate in the infrastructure-rich area to the west of London. The Danish and Finnish capital regions of Hovedstaden (9.6 %) and Helsinki-Uusimaa (9.4 %) and the Prov. Brabant Wallon (9.2 %) were the only other regions to record shares of at least 9.0 %.

**Figure 7.4:** Regional disparities in employment in high-tech sectors, by NUTS 2 regions, 2012 (1)
(% of total employment)




(1) The light purple shaded bar shows the range of the highest to lowest region for each country. The dark green bar shows the national average. The green circle shows the capital city region. The dark purple circles show the other regions. Severen tsentralen (BG32), Yugoiztochen (BG34), Anatoliki Makedonia, Thraki (EL11), Notio Aigaio (EL42), Alentejo (PT18) and Tees Valley and Durham (UKC1): 2011. Peloponnisos (EL25) and Molise (ITF2): 2010. Data for several regions have low reliability (too numerous to document).
*Source:* Eurostat (online data code: htec_emp_reg2)

There were 47 regions in the EU where less than 2.0 % of employment was in high-tech sectors in 2012 (as shown by the lightest shade in **Map 7.4**); note the information for some of these regions relates to previous reference periods. Nine of these 47 regions reported that high-tech sectors accounted for less than 1.0 % of their total employment: three of these were located in each of Greece (Anatoliki Makedonia, Thraki (2011 data); Peloponnisos (2010 data); Thessalia) and Romania (Sud-Est; Sud - Muntenia; Sud-Vest Oltenia), while there were two regions from Spain (Extremadura and the Canarias) and a single region from Poland (Swietokrzyskie). There were only four regions in Turkey where the share of employment in high-tech sectors reached 1.0 % or higher, while 22 regions recorded shares below this level.

## Patents

Patent counts can provide a measure of invention and innovation. However, care should be taken interpreting this data as not all inventions are patented and patent propensities vary across activities and enterprises. Furthermore, patented inventions vary in technical and economic value. As with the other indicators analysed in this chapter, patent applications tend to be clustered geographically in a limited number of regions and this is especially true for high-tech patents.

Regional statistics for patent applications to the European Patent Office (EPO) build on information from the addresses of inventors, which 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.

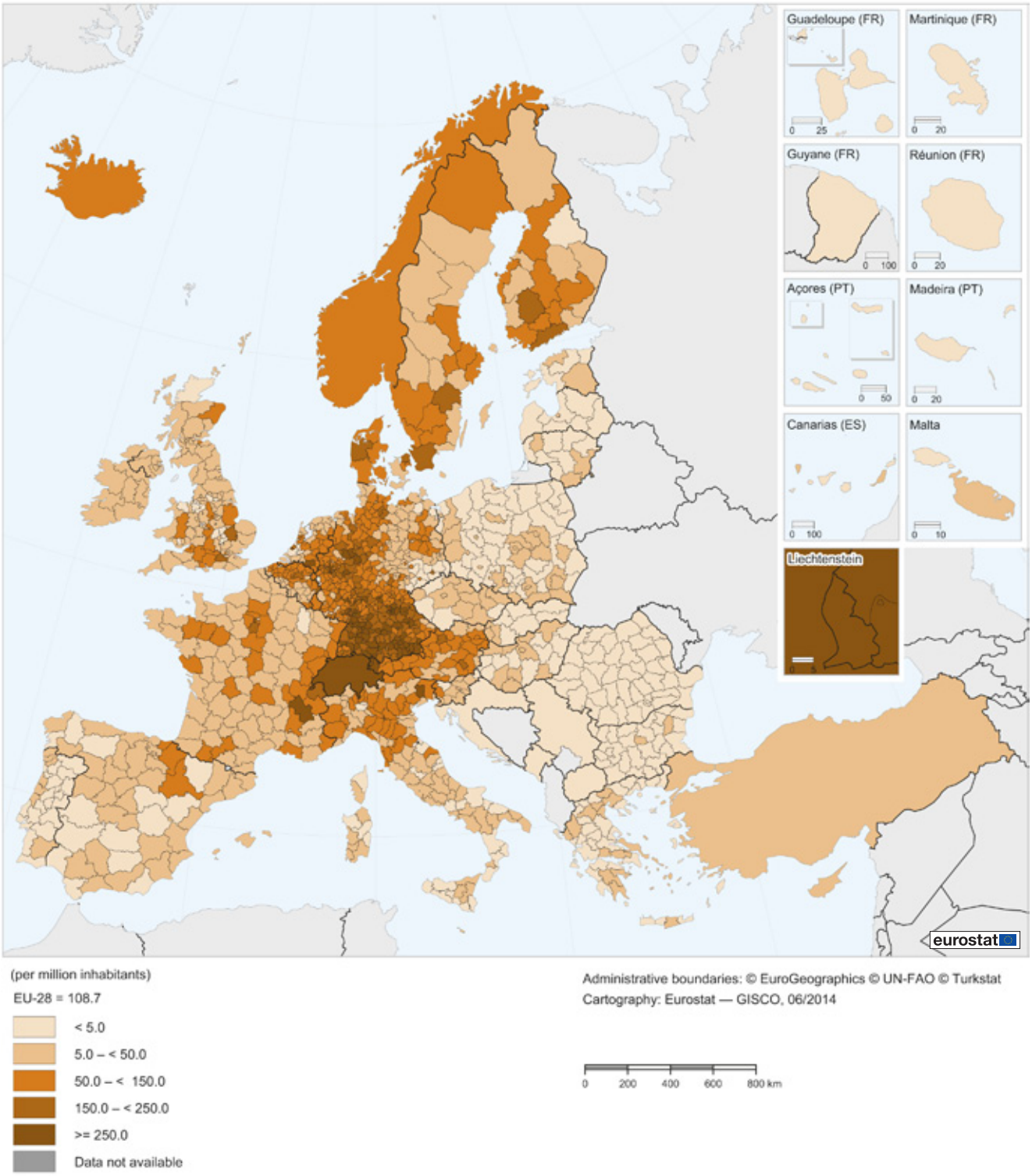
### *Patent applications in the EU were highly concentrated in (southern) Germany*

Across the EU-28, there were almost 55 thousand patent applications made to the EPO in 2010, equivalent to an average of 108.7 applications per million inhabitants. **Map 7.5** shows that technological activity in the form of patent applications was very much concentrated in the centre of the EU. There were 76 NUTS 3 regions in the EU (out of a total of 1 295 regions with data available) that had more than 250.0 patent applications per million inhabitants in 2010 (as shown by the darkest shade); of these, seven regions had more than 500.0 patent applications per million inhabitants.

Among the top 76 regions with the highest propensity for patent applications there were 70 German regions, as well as two regions from each of the Netherlands and Austria, and a single region from each of France and Italy. The high degree of innovative activity in (southern) Germany had a considerable impact on the EU-28 average. The highest number of patent applications per million inhabitants was recorded in the German region of Erlangen, Kreisfreie Stadt (1 177.9), while the third highest number (1 228.9) was registered in the neighbouring Bavarian region of Erlangen-Höchstadt. Erlangen is home to a number of research institutes, a university and various offices of the Siemens engineering group. The second highest number of patent applications (relative to population size) in 2010 was recorded in another Bavarian region, namely that of Regensburg, Kreisfreie Stadt, while the region of Regensburg, Landkreis recorded the fifth highest ratio. Regensburg is the location of a BMW manufacturing plant, while Siemens, Continental, Infineon and Toshiba also have plants in the region, and there is also a university and a range of high-tech biotechnology enterprises.

By contrast, the distribution of regions was heavily skewed in favour of those with a relatively low propensity to make patent applications, as witnessed by the median value of 37.1 patent applications per million inhabitants across all NUTS 3 regions in the EU, far below the EU-28 mean of 108.7. There were 301 NUTS 3 regions in the EU reporting less than 5.0 patent application per million inhabitants in 2010 (the lightest shade on **Map 7.5**; note that some of the information relates to earlier reference periods). These regions were principally spread across eastern Europe, the Baltic Member States, southern Italy and a number of regions in Spain and Portugal.

**Map 7.5:** Patent applications to the EPO, by NUTS 3 regions, 2010 (1)
(per million inhabitants)




(1) EU-28: estimate. All regional values for 2010: provisional. For several regions the latest data is for 2008 or 2009. Iceland: 2009. Croatia, Iceland, Liechtenstein, Norway, Switzerland and Turkey: national level and estimates.
*Source:* Eurostat (online data codes: pat_ep_rtot and pat_ep_ntot)

# 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 datasets, analysis (breakdowns), frequency and transmission delays. In 2012, Commission Regulation 995/2012 concerning the production and development of Community statistics on science and technology was adopted; this will apply to all R & D statistics from reference year 2012 onwards. 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 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 the EU LFS and structural business statistics (SBS)). The technology level of manufacturing activities is defined in terms of their R & D intensity (the ratio of R & D expenditure relative to value added).

For manufacturing, four groups are identified, depending on the level of R & D intensity: high, medium-high, medium-low and low-technology manufacturing sectors. High-technology manufacturing covers the manufacture of: basic pharmaceutical products and pharmaceutical preparations; computer, electronic and optical products; and air and spacecraft and related machinery.

For services, the activities are classified into knowledge-intensive services (KIS) and less knowledge-intensive services (LKIS). The former is then divided into high-tech knowledge-intensive services, knowledge-intensive financial services, knowledge-intensive market services (other than high-tech and financial services), and other 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, consultancy and related activities, information service activities, and research and development.

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 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 2 and NUTS 3 regions. Patent statistics published by Eurostat are almost exclusively based on the EPO worldwide statistical patent database, Patstat.